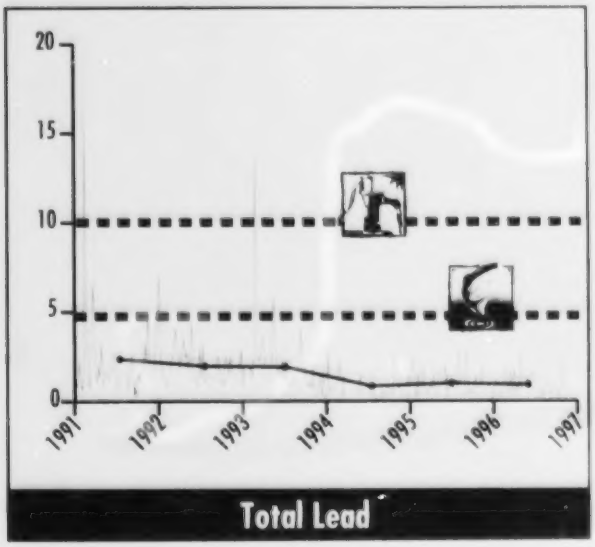
Water Quality Trends in Selected British Columbia Waterbodies



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Water Quality Trends in Selected British Columbia Waterbodies

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Water Quality Trends in Selected British Columbia Waterbodies

Ecosystem Goal for British Columbia

Clean, healthy and safe land, water and air for all living things and provision of social, economic and outdoor recreational opportunities consistent with maintaining a naturally diverse and healthy environment are goals of the Ministry of Environment, Lands and Parks and Environment Canada. This report examines the trends in water quality in selected British Columbia waterbodies over the last 10 to 20 years as an indicator of our progress in achieving these goals for water.

Data Source

To determine whether water is suitable for fish, wildlife and human uses, governments continually sample and analyze the waters of the province at selected locations. Over time, enough information on water quality has been accumulated to make it possible to examine the long-term trends in water quality at these locations. This report focuses on the trends in the fresh surface and ground water quality of British Columbia.

Trend Assessment

Trend assessment tries to determine whether water quality is improving, deteriorating or staying about the same over time. Water quality must be measured regularly using consistent methods over a period of at least five years to have enough data to assess the trends. Statistical tests are used to confirm the existence of trends, and water quality objectives and guidelines are used to judge their environmental significance.

Waterbodies Considered

The trends in 68 bodies of water have been assessed. These include 49 river sections or creeks, 14 lakes or reservoirs and 5 groundwater aquifers. The data from 133 monitoring stations in these 68 waterbodies were examined for trends. This report is the compilation of the trend reports for each waterbody. The waterbodies assessed range from those that are relatively pristine to those that are heavily impacted by human activity. However, because we monitor more in areas where people are active, this report gives a view of water quality in developed areas, rather than of undeveloped watersheds where water is still in a largely natural state.

Observed Water Quality Trends

For surface water (lakes and streams), 59% of the stations had no observed changes in water quality, 31% had improving trends, and 10% had deteriorating trends. For groundwater, 53% of the stations had no observed changes, 27% had improving trends, and 20% had deteriorating trends. **These trends are not considered to be representative of the water quality trends in the province as a whole.**

Future Action

The trend report for each waterbody indicates action that is underway or needed to improve or maintain water quality. This includes governments working with industries and municipalities to reduce waste discharges, as well as with local stewardship groups to tackle non-point sources of pollution that we all contribute to in one way or another. We are all stewards of this vital resource and must all help in the job of protecting water quality and correcting problems. Continued monitoring is a key to determine whether water quality is improving or being maintained over time.

FAITS SAILLANTS

Objectifs environnementaux pour la Colombie-Britannique

Un milieu terrestre, aquatique et atmosphérique propre, salubre et sûr pour tous les êtres vivants, de même que des conditions sociales et économiques et des structures de loisirs respectueuses de la diversité et de la qualité de l'environnement : tels sont les objectifs du ministère de l'Environnement, des Terres et des Parcs de la Colombie-Britannique et du ministère de l'Environnement du Canada. Ce rapport décrit les tendances de la qualité de l'eau dans divers types de milieux aquatiques de la Colombie-Britannique au cours des 10 à 20 dernières années, tendances qui sont indicatrices des progrès accomplis dans l'atteinte des objectifs environnementaux pour ce qui concerne le milieu aquatique.

Source de données

Afin de déterminer si l'eau est de qualité adéquate pour les besoins du poisson, de la faune et des êtres humains, les autorités procèdent continuellement à des échantillonnages et à des analyses de l'eau dans divers sites aquatiques de la province. Au fil des ans, on a recueilli suffisamment d'information sur la qualité de l'eau pour étudier les tendances à long terme de la qualité de l'eau pour les sites pris comme témoins. Ce rapport porte principalement sur les tendances de la qualité des eaux douces de surface et des eaux douces souterraines en Colombie-Britannique.

Étude des tendances

L'étude des tendances a pour objet de déterminer si la qualité de l'eau s'améliore, se dégrade ou reste stable avec le temps. La qualité de l'eau doit être mesurée régulièrement à l'aide de méthodes uniformes sur une période d'au moins cinq ans afin qu'on ait suffisamment de données pour dégager des tendances. Des tests statistiques sont utilisés pour confirmer l'existence des tendances dégagées, et les objectifs et directives en matière de qualité de l'eau sont utilisés pour déterminer leur portée environnementale.

Milieux aquatiques étudiés

Les tendances de 68 milieux aquatiques ont été étudiées : 49 sections de cours d'eau, 14 lacs ou réservoirs et 5 nappes aquifères. Les données de 133 stations de surveillance installées sur ces 68 sites ont été étudiées pour dégager les tendances qui les caractérisent. Ce rapport est la compilation des tendances observées pour chacun d'eux. Les milieux étudiés vont de ceux qui sont relativement intacts à ceux qui sont très altérés par l'activité humaine. Toutefois, comme on surveille davantage les milieux qui se trouvent à proximité des populations humaines, ce rapport porte principalement sur la qualité des milieux aquatiques situés à proximité des centres urbains plutôt que ceux situés dans les régions naturelles où l'eau est encore inaltérée.

Tendances observées en ce qui concerne la qualité de l'eau

En ce qui concerne les eaux de surface (lacs et cours d'eau), 59% des stations d'observation n'ont fait état d'aucun changement concernant la qualité de l'eau, 31% ont fait état d'améliorations et 10% ont fait état de dégradations. Pour ce qui est des eaux souterraines, 53% des stations n'ont fait état d'aucun changement, 27% ont fait état d'améliorations et 20% ont fait état de dégradations. **Ces tendances ne sont pas considérées comme représentatives des tendances de la qualité de l'eau pour la province dans son ensemble.**

Mesures proposées

Le rapport sur les tendances du milieu aquatique indique les moyens qui ont été pris ou qui devraient être pris afin d'améliorer ou de maintenir la qualité de l'eau. Ces moyens peuvent comprendre des structures de collaboration établies entre les industries et les municipalités pour réduire le dépôt de déchets dans le milieu, de même que la création de groupes de gérance locaux pour réduire les sources de pollution diffuse auxquelles nous contribuons tous d'une manière ou d'une autre. Nous sommes tous responsables de cette ressource vitale qu'est l'eau et nous devons tous contribuer à assurer sa protection et à trouver des solutions aux problèmes que pose sa qualité. La surveillance demeure un moyen clé pour déterminer si la qualité de l'eau s'améliore ou se maintient à un niveau acceptable.

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Finally, thanks to all of the water quality sample collectors whose diligence over the years has made this report possible.

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INTRODUCTION

Welcome to the water quality trend report for British Columbia

The following questions and answers will introduce you to the trend report, explain what it means and how it was derived, and guide you through its use.

Why prepare a water quality trend report for BC?

Environment Canada and the Ministry of Environment, Lands and Parks have been collecting technical data on surface water quality for many years through the Canada – B.C. Water Quality Monitoring Agreement. The Province has also been collecting data on the quality of groundwater in aquifers. Because of the growing public interest and demand for such information, we are publishing the data using a trend report format. This government reporting about the state of the resource can guide people in their decisions on how to use water, and promotes action to correct water quality problems. The Ministry of Environment, Lands and Parks published the BC Water Quality Status Report in 1996 to provide information to the public on the state of water quality, and this trend report is a companion report that focuses on long-term trends in water quality.

What is the trend report based on?

The trend report is based on data collected regularly and consistently over periods of 5 to 10 years or more. These data are evaluated to determine whether water quality is improving, deteriorating, or remaining about the same over the years. Water quality objectives or guidelines are used to assess the environmental significance of the trends.

What is regular and consistent monitoring?

Consistent monitoring means making the same measurement in the same way at the same location each time the waterbody is sampled over a period of five or more years. If locations or methods of sampling or measuring change over time, then it becomes difficult to tell whether a trend is due to a change in water quality or just a change in locations or methods. Regular monitoring means measuring at regular intervals (e.g., once per week, month or year) that are frequent enough to be representative of water quality for the waterbody. Typically, lakes and streams should be monitored at least once per month, although lakes can be also be monitored once per year in the spring, when the lake is well mixed. Groundwater can be less variable than surface water, and often quarterly or annual sampling is adequate for trend assessment in aquifers where the variability is low. Bottom sediments are also less variable than surface water, and often sampling once per year or every few years is sufficient.

What is the difference between the status report and the trend report?

The two reports are based on data collected in two different ways for two different purposes. The status report was based on the degree of attainment of water quality objectives during a critical month (when the objectives are most likely to be exceeded) for at least three consecutive years. It presented a snapshot of the state of water quality at critical times over the three years. The trend report is based on regular and consistent long-term monitoring (5 to 10 years or more), and shows whether the water quality is changing over the longer term.

What are water quality objectives?

Objectives are limits set for water quality indicators by the Ministry or Environment Canada to protect all designated uses of a specific body of water. They take into account the local water quality conditions and uses, and they establish a reference against which the state of water quality in the waterbody can be checked.

What are water quality guidelines?

Guidelines are safe levels of water quality indicators that apply province-wide or nationally to protect sensitive uses of water such as drinking, aquatic life, agriculture and recreation. They are used when objectives have not been established for a waterbody to provide a general reference against which the state of water quality can be checked.

Which uses of water are we talking about?

There are six sensitive uses of water, represented in the trend report by the six pictograms shown opposite. These water uses require a high quality of water, and must be protected against human sources of water pollution such as waste discharges and land use. Look for these pictograms on the trend graphs in the report to determine which water uses may have been affected.

What are the sources of water pollution?

The main potential sources of pollution are described in the trend report by the six pictograms shown opposite. Look for these pictograms on the detailed maps. These illustrate industrial plants, logging, mining, urban development, agriculture, and dams. Note that industrial plants encompass a range of operations from pulp mills to smelters to fish hatcheries, and that urban development includes sewage, septic system effluent, combined sewer overflows and stormwater runoff. The trend reports for each waterbody state what will or should be done to improve water quality in the waterbody, where applicable.

Water Uses

Sources of Water Pollution

What water quality indicators were measured?

A wide variety of chemical, physical and biological indicators of water quality were measured, and the trend report lists the indicators measured for each lake, stream or aquifer. The indicators include:

- **Major ions** such as calcium, chloride, fluoride, magnesium, potassium, silicon, sodium, and sulphate are present in all natural waters, but can be affected by waste discharges and land disturbance. **Dissolved solids** and **conductivity** were measured as overall indicators of changes in major ions. **Hardness** is the sum of calcium and magnesium, and affects the toxicity of metals and the aesthetic acceptability of drinking water.

- **Trace elements** include aluminum, arsenic, barium, beryllium, cadmium, chromium, cobalt, copper, iron, lead, lithium, manganese, molybdenum, nickel, selenium, strontium, vanadium, and zinc. These elements are normally present in minute amounts, but can be increased to harmful levels by waste discharges and runoff from land disturbances, transportation corridors and other developed areas.

- **Algae** are tiny plants that form the base of the aquatic food chain. If there are too few algae, the water will not be able to support productive fish populations. Conversely, too many algae (algal blooms or eutrophication), can harm drinking water, recreation, and fish habitat. Blooms of some types of algae can be fatal to livestock drinking the water. Algal abundance is measured by the amount of the pigment, **chlorophyll a**, in the algae floating in the water in lakes **(phytoplankton)** and attached to the bottom in streams **(periphyton)**. The algal community can also be characterized by identifying and counting the different kinds of algae in the water. **Extinction** or **Secchi depth** is a measure of water clarity in lakes, which is mainly affected by the amount of algae in the water. It is the depth of water at which a black and white disk can no longer be seen from the surface of the lake. The shallower the extinction depth, the more algae there are in the water.

- **Zooplankton** are tiny animals that feed on the algae floating in the water of lakes and oceans, and are in turn eaten by fish. The zooplankton community can be characterized by identifying and counting the different kinds of tiny animals in the water.

- **Nutrients:** forms of carbon, nitrogen and phosphorus, which are essential for aquatic plants such as algae. Waste discharges and land use can increase nutrient levels in water, causing too much algal, fungal or bacterial growth and harming water uses.

Conversely, dams can trap nutrients and decrease the levels in water, resulting in too few algae to support productive fish populations.

- **Nitrate:** a form of nitrogen that is particularly important in groundwater, where it can build up to levels that are toxic to humans drinking the water. Agricultural fertilizers and manure, and septic tank effluents can increase nitrate levels in groundwater.

- **pH:** a measure of the acid or alkaline nature of the water, which can be affected by waste discharges, acid precipitation, or too much algal growth.

- **Acidity:** a measure of the amount of acids in water as indicated by its ability to neutralize alkaline or basic substances. Acid precipitation and acidic effluents from mines and industry can increase the acidity of water to harmful levels. Non-point source pollution from animal waste runoff and woodwaste leachate can also cause acidic impacts to receiving waters.

- **Alkalinity:** a measure of the ability of the water to neutralize acids.

- **Non-filterable residue (suspended solids or sediment) and turbidity:** measures of the amount of particulate matter in water, which occur due to natural erosion of the Earth's surface, but can be affected by land disturbances, waste discharges, and dams.

- **Colour:** the colour of water ranges naturally from nil to tea-coloured, depending on the amounts of organic and inorganic material dissolved in the water. Pulp mills and some other industrial effluents can increase the colour of water to objectionable levels.

- **Fecal coliforms:** bacteria that naturally inhabit the intestines of warm-blooded animals and are indicators of the presence of their feces in water. Improper treatment and disposal of human sewage and animal manure can cause fecal contamination of water that degrades it for drinking, swimming, irrigation, and shellfish harvesting.

- **Cyanide:** a substance that is often discharged from mining, smelting, and petroleum industries. Gold milling is a notable source of cyanide in B.C. Cyanide is toxic to humans, plants, and animals.

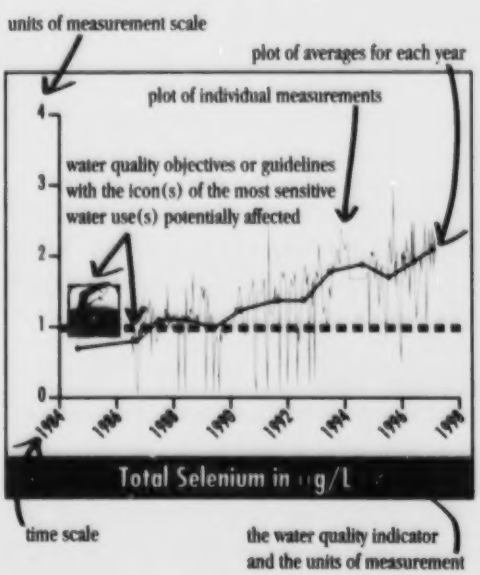
- **Adsorbable organic halides (AOX)**: a general indicator of chlorinated organic compounds such as chemicals generated by pulp mills using chlorine to bleach wood pulp.

- **Temperature** is governed by the climate and weather conditions in the watershed. It may be affected on a global scale by greenhouse gases, and on a local scale by dams, water diversions, streamflow reductions or increases, removal or planting of shade trees, and discharges of heated cooling waters from industrial plants.
- **Total dissolved gases:** the amount of air that is dissolved in water. Spillways of dams are the main human cause of too much air dissolved in water, which can be harmful to fish.
- **Dissolved oxygen** is a vital part of the air that is dissolved in water. Minimum amounts are essential for aquatic organisms to breathe. It can be depleted to harmfully low levels by bacteria consuming the organic matter in sewage, industrial effluents, agricultural wastes, and decaying algal blooms.
- **Flow:** streamflow is not usually considered to be a water quality indicator, but it has an important effect on the levels of many water quality indicators. Typically, peak flows have increased levels of suspended solids and related indicators, while low flows are associated with increased levels of dissolved ions.

How are water quality concerns identified?

The water quality measurements for a waterbody are compared to the relevant water quality objectives or guidelines to identify potential concerns where the measurements exceed the objectives or guidelines.

What do the trend graphs show?



How are the trends determined?

The water quality measurements for a waterbody are plotted on a graph over time, along with the relevant water quality objectives or guidelines. The graphs are inspected for "environmentally significant" trends – where the measurements are increasing or decreasing over time and the levels are close to the objectives or guidelines, or are otherwise judged to represent an important change in water quality. These trends are further evaluated to ensure that they were not caused by measurement errors, to identify their causes, and to determine whether they are statistically significant. A confidence level of 95% or better is used to define statistical significance, unless noted otherwise.

What is the scope of this report?

This report covers trend reports for 68 bodies of water, including 49 streams, 14 lakes or reservoirs, and 5 groundwater aquifers, where water quality measurements have been made regularly and consistently for more than five years. An aquifer is an underground sand, gravel or rock deposit where the spaces between the solids are filled with water. The waterbodies range from those that are relatively

pristine to those that are heavily impacted by human activity. Since we tend to measure in areas where people are active, this report will give a view of water quality in developed areas, rather than for undeveloped watersheds where water is still in a largely natural state.

How well does the trend report represent B.C. waters?

There are thousands of lakes, streams and aquifers where water is in a largely natural state. On the other hand, there are also bodies of water where problems exist, but where we do not have enough data to prepare a trend report or where we haven't had the time or resources to prepare a trend report. The 68 waterbodies represent only a small sample of the thousands of waterbodies in the province, and the water quality indicators measured represent only a fraction of the characteristics that could be measured. In addition to being a small sample of waterbodies, the sample is also biased towards waterbodies where human activity occurs. Because of this, the trend report should be viewed as being representative only of the waterbodies and indicators measured, as opposed to being indicative of the trends in water quality of the province as a whole. An unbiased overall view of water quality trends for the province would require the long-term monitoring of a larger number of waterbodies that would be selected at random, without regard for expected water quality concerns. It should also be remembered that the water quality of a trend monitoring station may only be representative of the condition of the waterbody at, or near, the station – there may be localized conditions in the waterbody that are quite different.

What other water quality monitoring is being done?

Other waterbodies and water quality indicators are monitored in B.C. by many federal, provincial, regional, municipal, stewardship, and private agencies for a variety of purposes. If the measurements are made regularly and consistently over time, they may provide insights into water quality trends in the province in addition to those presented in this report. Information on other waterbodies or indicators of concern is available from the regional staff of the Ministry of Environment, Lands and Parks and Environment Canada, or from sources such as the 1996 B.C. Water Quality Status Report and State of Environment Reports.

How is the report organized?

The waterbodies are compiled according to the Ministry of Environment, Lands and Parks' seven regions listed in the Table of Contents, and as shown on the map of the Province on page 10. We then present a map of each region, which identifies the waterbodies discussed, and a regional summary of the trends. Each waterbody has one or two

pages describing the trends in water quality and a more detailed map showing the main features that influence water quality. There is an index at the back which lists all of the waterbodies alphabetically.

Are the data also presented to show the big picture?

A summary of trends is presented for the whole Province (see page 11) and for each region of the Ministry. Each summary shows, on maps or in tables, the waterbodies with improving or deteriorating water quality or where no changes are evident. Look for the regional summaries following each regional map.

What will Government do with this information?

The trend reports state what is being done or will be done to improve water quality where there are deteriorating trends or other water quality concerns, and to maintain water quality where there are no present concerns.

What can I do, as a member of the public, to improve water quality?

It's easy to feel that our individual actions don't make any difference. But each of us, through our actions and purchasing habits can promote changes within our families, workplaces, and local communities that can have immediate, positive effects on water quality. Here are some of the things that you can do:

Around Your Home

- Reduce your use of household hazardous products and use less harmful alternatives when you can. Do not dispose of them into storm drains – if possible take them to recycling or collection centres.
- Use phosphate-free soaps and detergents.
- Regularly check and repair fluid leaks from your vehicle.
- Recycle used oil and antifreeze.
- Reduce or eliminate use of fertilizers and pesticides on your lawn and garden. If you must use them, do so sparingly and follow instructions carefully. Slow-release fertilizers and non-persistent pesticides are recommended. Use natural pest control products whenever possible.

For Onsite Sewage System Users

- Have your septic tank inspected and pumped out every 3 to 5 years.
- Don't put solids or toxic chemicals down the drain and avoid using garburators.
- Don't over-water the lawn, allow vehicle traffic, or put heavy objects on your septic field.

For Boaters

- Don't release sewage in marinas, bays, or inlets; store it in holding tanks or portable toilets. Use pump-out stations where available or only release sewage in open waters. The Pleasure Craft Sewage Pollution Prevention Regulations under the Canada Shipping Act ban the release of raw sewage from pleasure boats in designated bodies of water.
- Use water, a scrub brush and biodegradable products to clean your boat instead of chemical cleaners.
- Keep motors well maintained to prevent fuel and lubricant leaks.

Around Your Farm or Ranch

- Reduce or eliminate the use of fertilizers, herbicides, and pesticides. If you must use them, follow instructions and provincial application guidelines carefully. Consider using natural pest control methods.
- Construct adequate manure storage facilities and follow manure spreading guidelines.
- Prevent damage of areas along streams through fencing or providing restricted access to livestock.

You can also make a difference by:

- Joining or forming a community stewardship group to care for a local waterbody.
- Participating in local community planning and regional growth strategies.
- Encouraging your neighbours, local employers and community leaders to implement water quality protection measures.

Where can I get more information on water quality?

Staff in the Ministry's regional offices or Environment Canada can provide information on the specifics in each trend report. These contacts are listed in each regional summary. The regional staff can also handle concerns about waterbodies not listed here. For more general information on the water quality trends, the method of evaluating trends, and on water quality objectives or guidelines, please contact:

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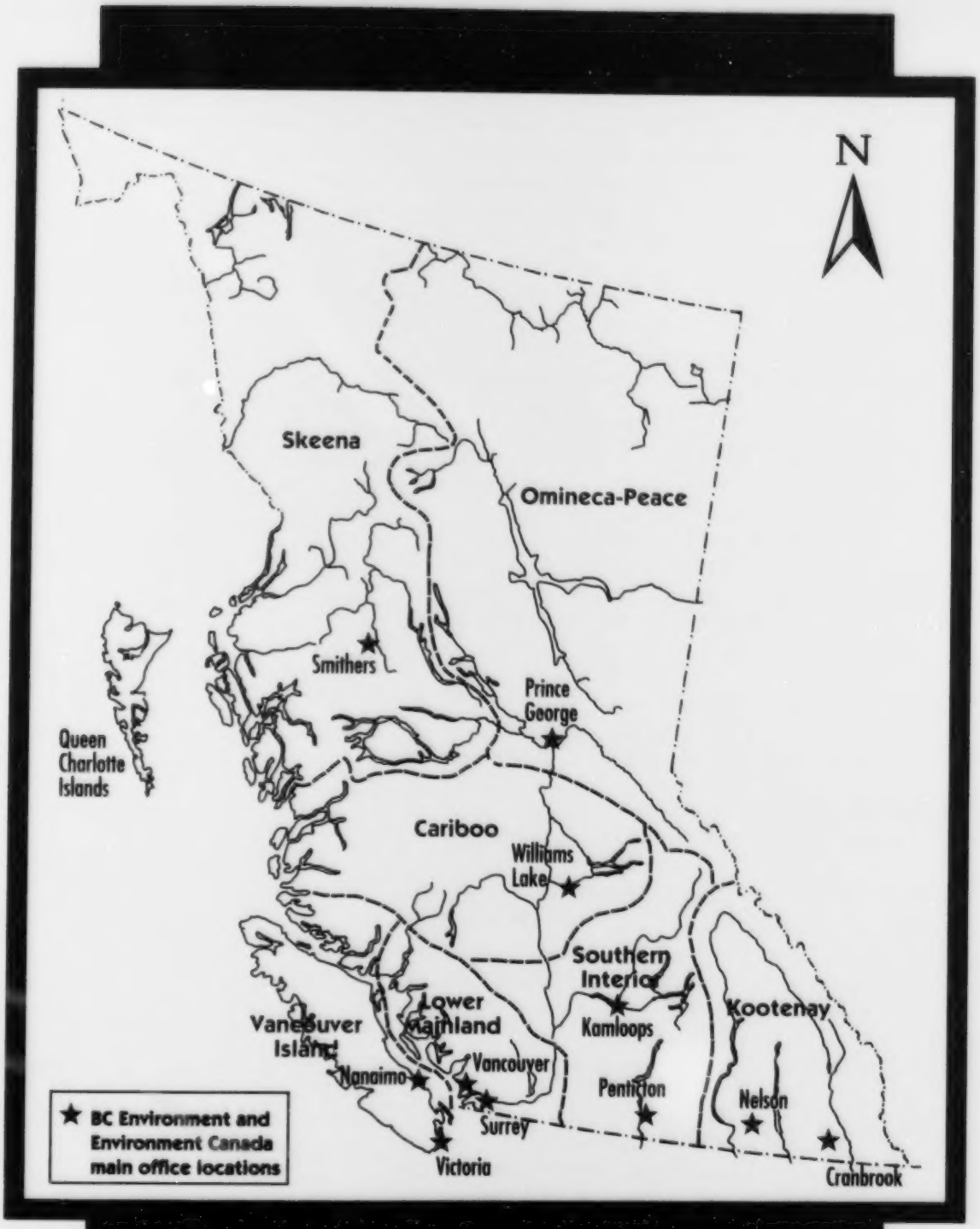


Administrative Regions of the Ministry of Environment, Lands & Parks

TRENDS OVERVIEW

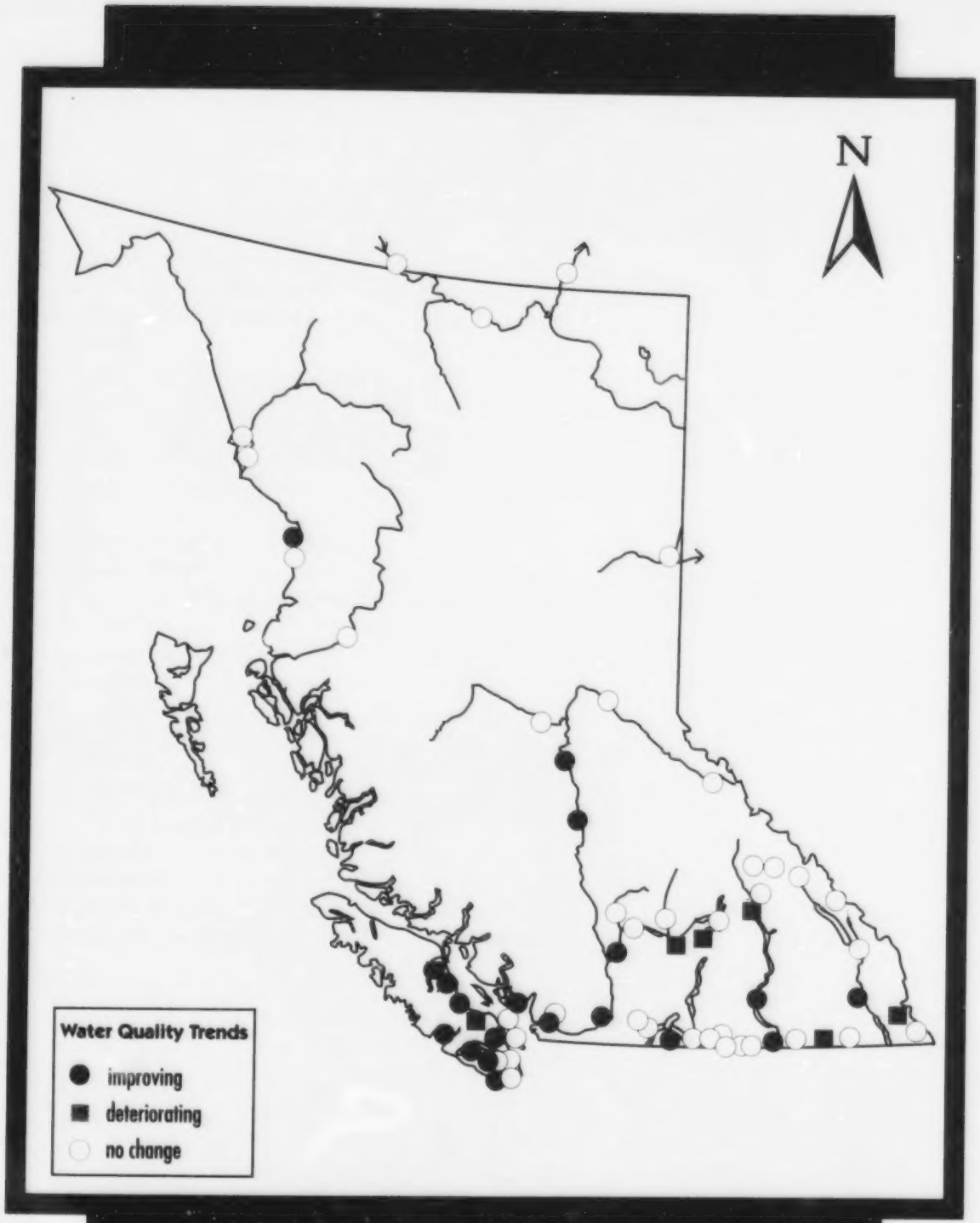
The Ministry of Environment, Lands and Parks has divided the Province into seven administrative regions, as shown on the map opposite. For this reason, the waterbodies are grouped by Region using a one– or two–page trend report for each waterbody.

The total number of waterbodies assessed for trends for all Regions is 68. These include 14 lakes, 49 streams (such as rivers and creeks), and 5 groundwater aquifers. There were a total of 133 water quality trend monitoring stations in the 68 waterbodies: 69 for lakes and streams and 64 for aquifers. The maps and tables on the following pages show how the water quality trends are distributed among the 133 monitoring stations. Three types of trends are identified: deteriorating, improving, and no change. The tables also identify where there are water quality concerns although there has been no change over time.

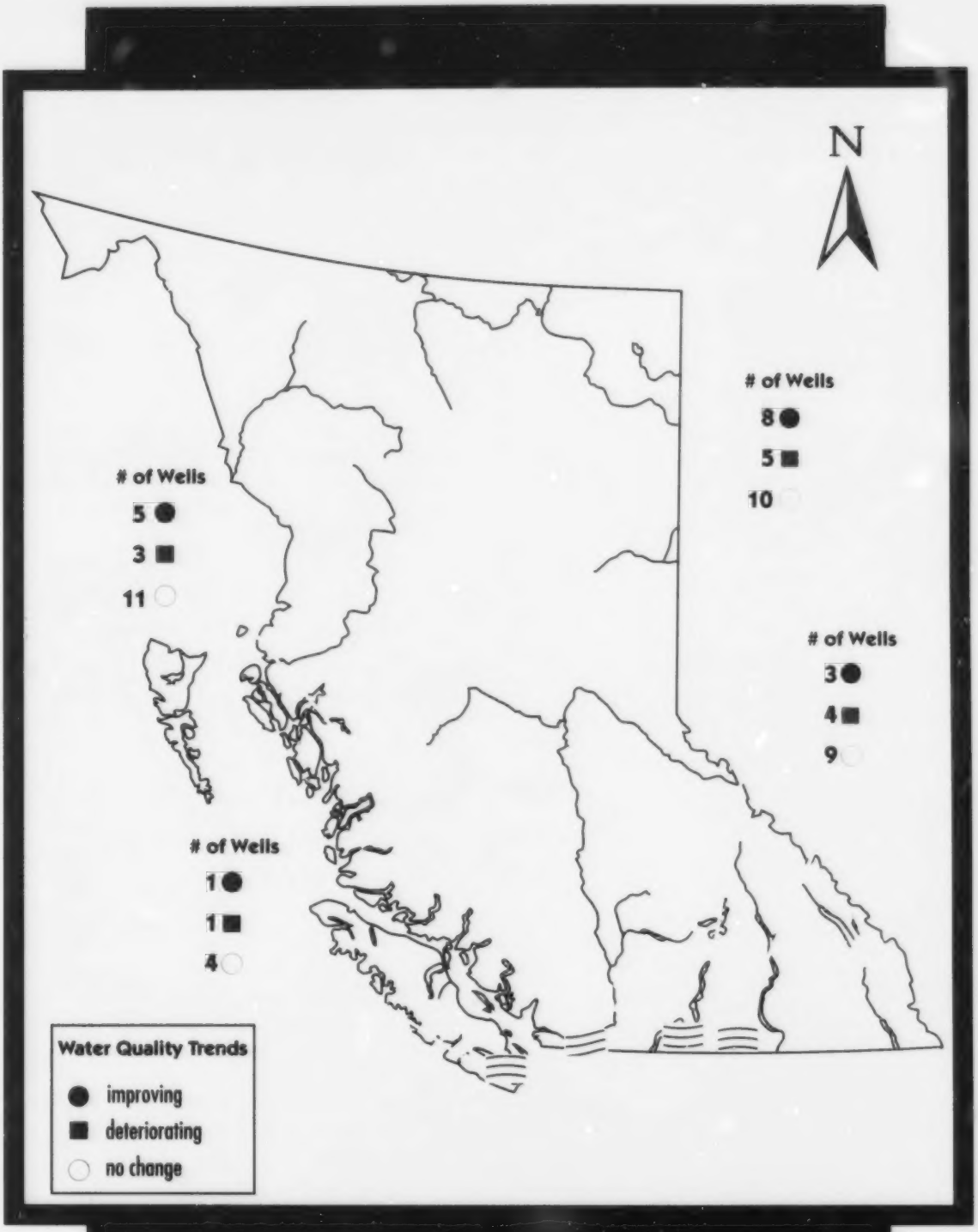
For surface water stations, the majority of stations, 59%, had no observed changes in water quality over time. Improving water quality was found at 31% of the stations, while deterioration was noted at 10% of the stations. Thus, overall, 90% of the stations were stable or had improving trends, while 10% showed deterioration.

For groundwater stations, 53% of the stations had no observed changes, 27% were improving, and 20% were deteriorating. Thus, overall, 80% of the stations were stable or improving, while 20% were deteriorating.

These 68 waterbodies represent only a small sample of the thousands of water-bodies in the province, and the data reflect only the conditions in the selected waterbodies. As well, the water quality and trends at a monitoring station may only be representative of the condition of the waterbody at or near the station; localised conditions in the watershed or aquifer may be quite different.



Summary of Surface Water Quality Trends in British Columbia



Summary of Groundwater Quality Trends in British Columbia

Deteriorating Trends in Water Quality

Location (Years)	Water Quality Indicators	Cause of Trend	Water Uses at Risk	Action
Lower Mainland Region				
Abbotsford-Sumas Aquifer – 3 of 19 wells (1992–98)	Nitrate	Non-point source pollution	Drinking water	Continued waste abatement and monitoring.
Southern Interior Region				
Salmon River at Salmon Arm (1988–97)	Turbidity	Agricultural and forestry non-point sources	Aquatic life and recreation	Continued abatement and monitoring.
South Thompson River at Kamloops (1987–97)	Suspended solids	Agricultural, forestry and residential non-point sources	Drinking water, aquatic life and recreation	Continued abatement and monitoring. Alternate drinking water sources and treatment options are being evaluated.
Grand Forks Aquifer – 4 of 16 wells (1990–98)	Nitrate	Agricultural and residential non-point sources	Drinking water	Continued abatement, monitoring and development of aquifer protection plan.
Osoyoos Aquifers – 5 of 23 wells (1992–97)	Nitrate	Agricultural and residential non-point sources	Drinking water	Continued abatement and monitoring.
Omineca-Peace Region and Skeena Region	None			
Vancouver Island Region				
Quinsam River (1986–96)	Sulphate & other major ions	Coal mining	Aquatic life – potential effects, no direct threat at present	Investigation underway at coal mine. Continued monitoring.
Quamichan Lake (1973–97)	Fecal coliforms	Waterfowl	Recreation (swimming)	Remediation plan, expanded monitoring and stewardship needed. Basic monitoring is continuing.
Cowichan Estuary Lower Aquifer – 1 of 6 wells (1985–94)	Total dissolved solids	Local pumping of aquifer	Drinking water & irrigation	Resume monitoring and report to local groups.
Kootenay Region				
Elk River (1984–97)	Selenium Nitrogen	Coal mining Coal mining	Aquatic life Recreation	Studies are underway and monitoring is continuing.
Kootenay River at Creston (1979–97)	Phosphorus	Dam/reservoir	Aquatic life (declining Kootenay Lake fish production)	Fertilization of Kootenay Lake since 1992. Monitoring is continuing.
Columbia River at Revelstoke (1984–97)	Phosphorus	Dams/reservoirs	Aquatic life (limits fish production)	Studies have been done and fertilization of Upper Arrow Reservoir began in 1999.
Cariboo Region	None			

Improving Trends in Water Quality

Location (Years)	Water Quality Indicators	Cause of Trend	Water Uses at Risk	Action
Lower Mainland Region				
Fraser River at Hope (1979–97)	AOX Chloride	Waste abatement at pulp mills	Aquatic life, and their human and wildlife consumers	Monitoring is continuing.
Abbotsford-Sumas Aquifer – 5 of 19 wells (1992–98)	Nitrate	Non-point source pollution	Drinking water	Continued waste abatement and monitoring.
Lower Fraser River Sediments (4 stations) (1985–96)	Lead	Reduction and ban of leaded gasoline	Aquatic life and wildlife	Ban on leaded gasoline remains in place. Monitoring is continuing.
Southern Interior Region				
Salmon River at Salmon Arm (1985–97)	Fecal coliforms	Agricultural non-point source abatement	Recreation, irrigation and livestock watering	Continued abatement and monitoring.
Thompson River at Spences Bridge (1985–97)	Chloride (indicator of chlorinated organics)	Pulp mill waste abatement	Aquatic life	Continued abatement and monitoring.
Grand Forks Aquifer – 3 of 16 wells (1991–98)	Nitrate	Agricultural and residential non-point source abatement	Drinking water	Continued abatement and monitoring.
Osoyoos Aquifers – 8 of 23 wells (1992–97)	Nitrate	Agricultural and residential non-point source abatement	Drinking water	Continued abatement and monitoring.
Similkameen River near US Border (1979–97)	Arsenic	Unknown	Aquatic life and drinking water	Continued monitoring.
Omineca-Peace Region				
Fraser River at Stoner (1990–97)	AOX	Pulp mill waste abatement	Aquatic life, and their wildlife and human consumers	Monitoring is continuing.
Skeena Region				
Salmon River near Hyder, Alaska (1990–97)	Cyanide	Uncertain	Aquatic life and wildlife	None required. Monitoring is continuing.

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Improving Trends in Water Quality

Location (Years)	Water Quality Indicators	Cause of Trend	Water Uses at Risk	Action
Vancouver Island Region				
Pyrrhotite Creek (Tsolum River) (1985–98)	Copper	Mine reclamation	Aquatic life	Continued reclamation and monitoring.
Stocking Lake (1985–95)	Phosphorus	Unknown	Drinking water	Monitoring is continuing.
Maxwell Lake (1985–95)	Phosphorus	Unknown	Drinking water	Monitoring is continuing.
Cowichan Estuary Lower Aquifer – 1 of 6 wells (1985–93)	Total dissolved solids	Uncertain	Drinking water and irrigation	Monitoring has resumed and will report to local groups.
Shawnigan Lake (1976–98)	Phosphorus	Unknown	Drinking water, aquatic life and recreation	Monitoring is continuing.
Lizard Lake (1985–95)	Phosphorus	Unknown	Aquatic life and recreation	Monitoring has resumed.
Spectacle Lake (1985–92)	Phosphorus	Unknown	Aquatic life and recreation	None needed.
Old Wolf Lake (1985–95)	Phosphorus	Unknown	Aquatic life and recreation	Monitoring is continuing.
Langford Lake (1979–98)	Phosphorus	Lake aeration and unknown	Aquatic life and recreation	A lake stewardship group has been formed and additional monitoring is being done. Aeration and basic monitoring are continuing.

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Improving Trends in Water Quality

Location (Years)	Water Quality Indicators	Cause of Trend	Water Uses at Risk	Action
Kootenay Region				
Kootenay River at Fenwick Station (1991–96)	Zinc	Waste abatement	Aquatic life	Continued waste abatement and monitoring.
Columbia River at Birchbank 1983–97)	Iron, aluminum	Dams/reservoirs	Drinking water, aquatic life	Abatement for total dissolved gases is being planned. Monitoring is continuing.
Columbia River at Waneta (1983–96)	Cadmium, chromium iron, lead, zinc, fluoride, sulphate, phosphorus	Waste abatement	Aquatic life, drinking water, irrigation, recreation	Continued abatement for cadmium, chromium, copper, zinc, and total dissolved gases. Monitoring is continuing.
Cariboo Region				
Fraser River at Marguerite (1985–96)	AOX Chloride	Pulp mill waste abatement	Aquatic life, and their wildlife and human consumers	Monitoring is continuing.
	Fecal coliforms	Improved sewage treatment	Drinking water, recreation and irrigation	Further monitoring and investigation will be done.

No Changes in Water Quality – Other Water Quality Concerns

Location (Years)	Water Quality Indicators	Concern	Water Uses at Risk	Action
Lower Mainland Region				
Abbotsford-Sumas Aquifer – 11 of 19 wells (1992–98)	Nitrate	Elevated levels	Drinking water	Continued monitoring.
Marion (Jacobs) Lake (1984–94)		None		None needed.
Southern Interior Region				
Salmon River at Salmon Arm (1988–99)	Phosphorus Water temperature	Elevated loadings to Shuswap Lake High in summer	Recreation Aquatic life	Continued abatement and monitoring.
Eagle River at Solsqua Road (1985–95)	Suspended solids, turbidity	Riverbank erosion	Aquatic life	Will be considered for watershed restoration.
North Thompson River at North Kamloops (1987–96)	Fecal coliforms	Exceeded objective at times	Drinking water	Monitoring is continuing and the applicability of the objective will be re-evaluated.
Bonaparte River near mouth (1986–95)	Fecal coliforms, turbidity, suspended solids, algae	Agricultural non-point sources of pollution and sewage treatment plant effluents	Aquatic life, drinking water recreation, irrigation, livestock watering	Remediation of non-point sources is continuing and sewage treatment plants have been upgraded.
Nicola River at Spences Bridge (1992–97)	Phosphorus	Agricultural non-point sources of pollution	Aquatic life	Remediation of non-point sources is being encouraged. Monitoring is continuing.
Kettle River at Midway (1980–95)		None at present		Monitoring is continuing.
Boundary Creek at Midway (1980–94)		None		None needed.
Kettle River at Carson (1980–95)		None at present		Monitoring is continuing.
Grand Forks Aquifer – 9 of 16 wells (1991–98)	Nitrate	Elevated levels	Drinking water	Continued monitoring.
Kettle River at Gilpin (1980–95)		None		Monitoring is continuing at Midway and Carson.
Okanagan River at Oliver (1980–97)	Water temperature	High in summer	Coldwater aquatic life	Monitoring is continuing.
Osoyoos Aquifers – 10 of 23 wells (1992–97)	Nitrate	Elevated levels	Drinking water	Continued monitoring.
Similkameen River at Princeton (1989–97)		None		Monitoring is continuing.
Similkameen River above Hedley (1989–97)		None		Monitoring is continuing at Princeton & near US border.

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No Changes in Water Quality – Other Water Quality Concerns

Location (Years)	Water Quality Indicators	Concern	Water Uses at Risk	Action
Omineca-Peace Region				
Liard River at Upper Crossing (1983–94)		None		Monitoring is continuing.
Liard River at Lower Crossing (1984–94)		None		Monitoring is continuing at Upper Crossing and Fort Liard.
Liard River at Fort Liard (1984–95)		None		Monitoring is continuing.
Peace River above Alces River (1984–94)	Turbidity, suspended solids, metals	High levels during spring freshet	Aquatic life, drinking water, recreation	Monitoring is continuing to assess the effects.
Fraser River at Red Pass (1985–94)		None		Monitoring is continuing.
Fraser River at Hansard (1985–94)		None		Monitoring is continuing.
Nechako River at Prince George (1985–95)		None		Monitoring is continuing.
Skeena Region				
Stikine River above Choquette River (1981–94)		None		None needed.
Iskut River below Johnson River (1981–94)		None		Monitoring is continuing.
Bear River at Stewart (1987–94)	Selenium	Often exceeded guidelines. May be natural or due to old mines.	Aquatic life	Survey of selenium sources will be done.
Salmon River near Hyder, Alaska (1990–97)	Selenium	Often exceeded guidelines. May be natural or due to old mines.	Aquatic life	Survey of selenium sources will be done. Monitoring is continuing.
Skeena River at Usk (1985–94)		None		Monitoring is continuing.

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No Changes in Water Quality – Other Water Quality Concerns

Location (Years)	Water Quality Indicators	Concern	Water Uses at Risk	Action
Vancouver Island Region				
Tsolum River 500 m downstream from Murex Creek (1989–97) Tsolum River at Farnham (1987–94) Murex Creek at Duncan Main (1986–97)	Copper	Drainage from mine on Mt Washington is toxic to fish	Aquatic life	Tsolum River Task Force is leading remediation. Monitoring is continuing.
Elk Lake (1983–98)	Phosphorus, Dissolved oxygen, Algae	Eutrophication	Aquatic life and recreation	Basic monitoring is continuing. Watershed planning, remediation and expanded monitoring are desirable.
Glen Lake (1981–98)	Phosphorus, Dissolved oxygen, Fecal coliforms	Eutrophication Fecal contamination	Aquatic life and recreation	Basic monitoring is continuing. Watershed planning, remediation and expanded monitoring are desirable. The lake aerator needs to be replaced.
St. Mary Lake (1974–98)	Phosphorus	Eutrophication	Drinking water, aquatic life and recreation	Basic monitoring is continuing. Watershed planning, remediation and expanded monitoring are desirable.
Cusheon Lake (1974–98)	Phosphorus	Eutrophication	Drinking water, aquatic life and recreation	Basic monitoring is continuing. BC Environment will support the local stewardship group in monitoring and watershed management planning.
Prospect Lake (1980–98)	Phosphorus Fecal colifroms	Eutrophication Fecal contamination	Drinking water, aquatic life and recreation	Watershed planning is underway. Monitoring is continuing.
Cowichan Estuary Lower Aquifer – 4 of 6 wells (1985–93)		None		Monitoring will resume at key wells.

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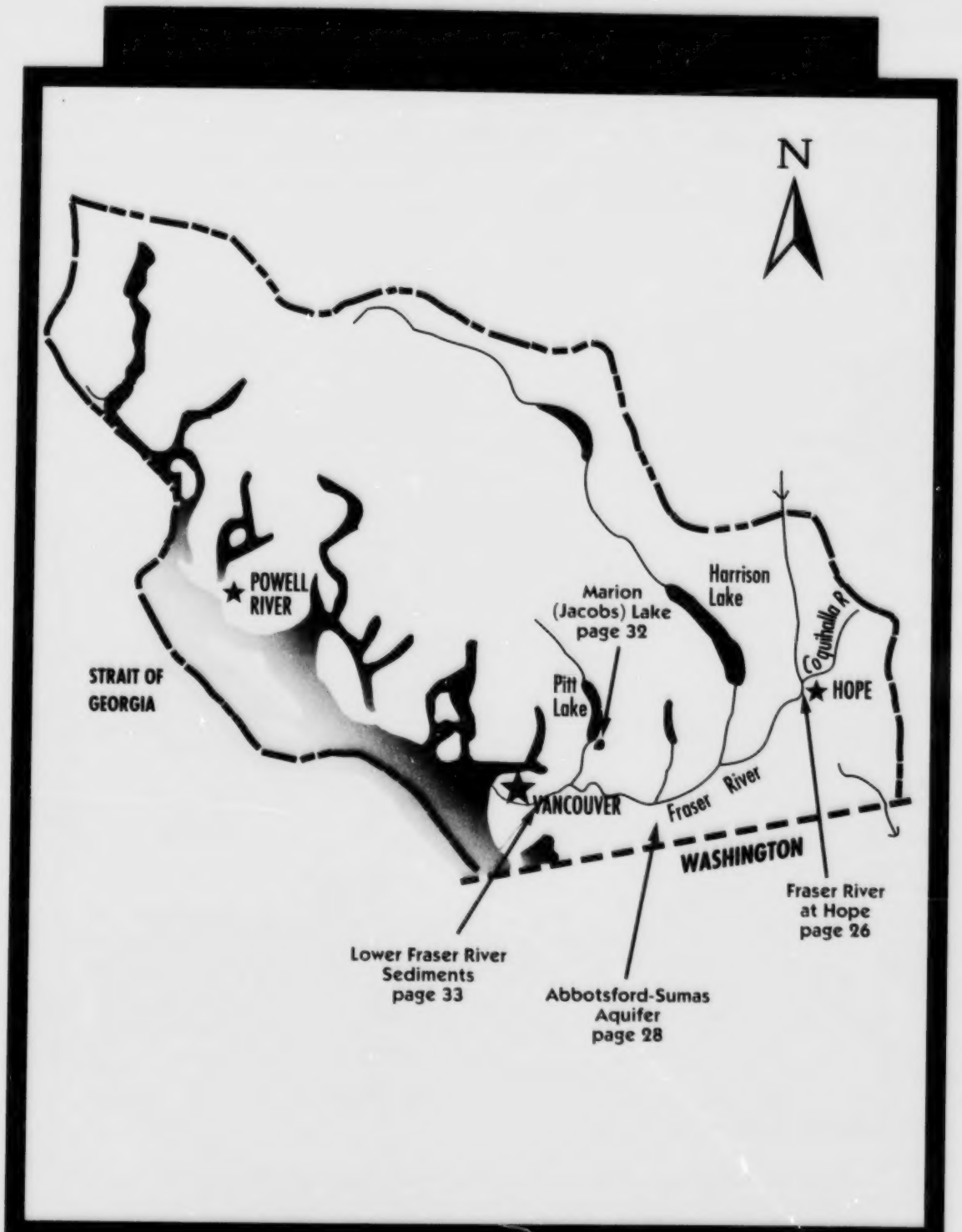
No Changes in Water Quality – Other Water Quality Concerns

Location (Years)	Water Quality Indicators	Concern	Water Uses at Risk	Action
Kootenay Region				
Kickinghorse River above Field 1987–95		None		Monitoring is continuing.
Beaver River in Glacier National Park 1987–95		None		Monitoring is continuing.
Columbia River at Donald 1984–95		None		None needed.
Illecillewaet River in Glacier National Park 1987–95		None		Monitoring is continuing.
Kootenay River at Kootenay Crossing 1987–95		None		Monitoring is continuing.
Kootenay River at Canal Flats 1985–95		None		Monitoring is continuing.
Moyie River at Kingsgate 1979–95		None		None needed.
Flathead River at US Border 1979–95		None		None needed.
Pend D'Oreille River at Waneta 1980–95	Total dissolved gases	Dams have caused levels that are harmful to fish.	Aquatic life	Means of reducing total dissolved gases are being investigated. Monitoring is continuing.
Big Sheep Creek near US Border 1979–95		None		None needed.
Cariboo Region				
None		None		None



Lower Mainland Region

LOWER MAINLAND REGION SUMMARY

The Lower Mainland Region is located in the southwestern part of the Province, bordering Washington State. It extends from the Coquihalla River in the east to Georgia Strait in the west, as shown on the map opposite. The main BC Environment regional office is located in Surrey.

The Fraser River at Hope, the bottom sediments in the lower Fraser River, Marion (Jacobs) Lake near Pitt Lake, and the Abbotsford-Sumas groundwater aquifer were monitored over the long term. The Fraser River at Hope and the sediments of the lower Fraser River had improving trends, Marion Lake had no changes, while the Abbotsford-Sumas aquifer had a mix of improving, deteriorating and no change trends. The water quality trends in these waterbodies are summarized in the table on the next page. It should be noted that a substantial amount of water quality monitoring has been done in the Greater Vancouver Regional District (GVRD) over the last 20 years, but that the assessment of these data for trends was beyond the scope of this project.

If you have any questions on the trend reports or want more information on other waterbodies in the Region, please contact:

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Deteriorating Trends in Water Quality

Location (Years)	Water Quality Indicators	Cause of Trend	Water Uses at Risk	Action
Abbotsford-Sumas Aquifer – 3 of 19 wells (1992–98)	Nitrate	Non-point source pollution	Drinking water	Continued waste abatement and monitoring.

Improving Trends in Water Quality

Location (Years)	Water Quality Indicators	Cause of Trend	Water Uses at Risk	Action
Fraser River at Hope (1979–97)	AOX Chloride	Waste abatement at pulp mills	Aquatic life, and their human and wildlife consumers	Monitoring is continuing.
Abbotsford-Sumas Aquifer –5 of 19 wells (1992–98)	Nitrate	Non-point source pollution	Drinking water	Continued waste abatement and monitoring.
Lower Fraser River Sediments (4 stations) (1985–96)	Lead	Reduction and ban of leaded gasoline	Aquatic life and wildlife	Ban on leaded gasoline remains in place. Monitoring is continuing.

No Changes in Water Quality – Other Water Quality Concerns

Location (Years)	Water Quality Indicators	Concern	Water Uses at Risk	Action
Abbotsford-Sumas Aquifer – 11 of 19 wells (1992–98)	Nitrate	Elevated levels	Drinking water	Continued monitoring.
Marion (Jacobs) Lake (1984–94)		None		None needed.

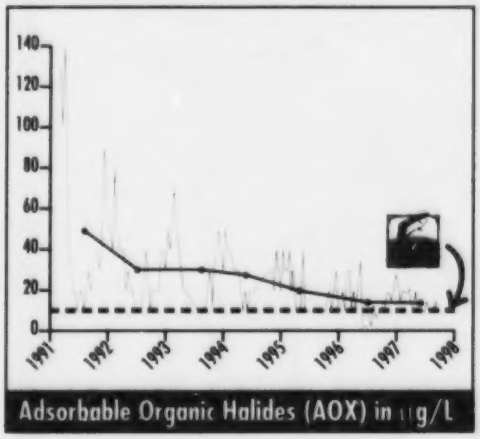
FRASER RIVER BASIN

Fraser River at Hope

What are the water quality trends?

The Fraser River at Hope had improving trends in chloride and adsorbable organo-halides (AOX), a measure of chlorinated organics, due to waste abatement at pulp mills along the Fraser and Thompson rivers.

Improving trends



Adsorbable Organic Halides (AOX) in µg/L

What are the main attributes of the Fraser River?

The Fraser River is one of B.C.'s most valued ecosystems, draining one-quarter of the province to Georgia Strait. Its drainage area at Hope is 217,000 km^2. The river near Hope is used for industrial water supply and recreation. It supports massive runs of all five species of Pacific salmon, as well as numerous species of resident fish. The Fraser River is a B.C. and Canadian Heritage River. Other major upstream stations in the basin are the Fraser River at Red Pass, Hansard, Stoner and Marguerite, the Nechako River at Prince George, and the Thompson River at Spences Bridge, as shown on the map on the previous page. These stations are discussed in the Omineca-Peace, Southern Interior and Cariboo Region sections of this report.

What are the main human influences on water quality?

Treated effluents from pulp mills at Prince George, Quesnel and Kamloops, treated municipal sewage effluents from Prince George, Quesnel, Williams Lake and Kamloops, and non-point sources of pollution from agriculture, forestry, and urban areas are the main human influences on water quality.

What water quality indicators were monitored?

Major ions, trace elements, nutrients, colour, dissolved and suspended solids, pH, and temperature have been monitored once every two weeks since 1979 at the Highway #1 bridge crossing at Hope. Monitoring of fecal coliforms began in 1987 and adsorbable organo-halides (AOX) began in 1991. Flow has been monitored continuously at the same location.

What are the water quality trends and what caused them?

Chloride and AOX declined since 1991 due to the reduction in chloride and AOX in the effluents of upstream pulp mills. This was caused by changes in the pulp bleaching process to reduce the use of elemental chlorine.

What is the environmental significance of the trends?

The declines in AOX and chloride indicate that chlorinated organics, which can be toxic to aquatic life and to humans and wildlife that

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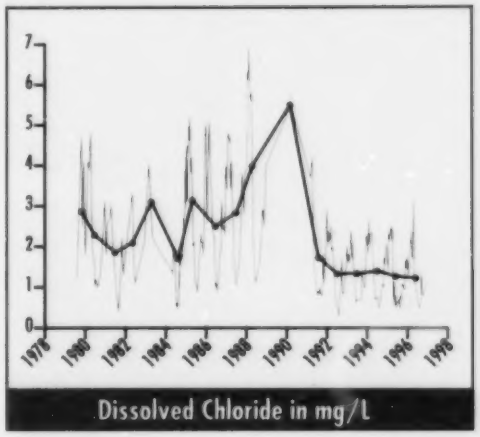
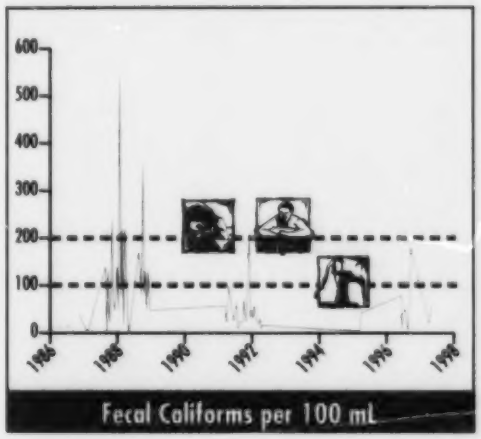


Dissolved Chloride in mg/L



Fecal Coliforms per 100 mL

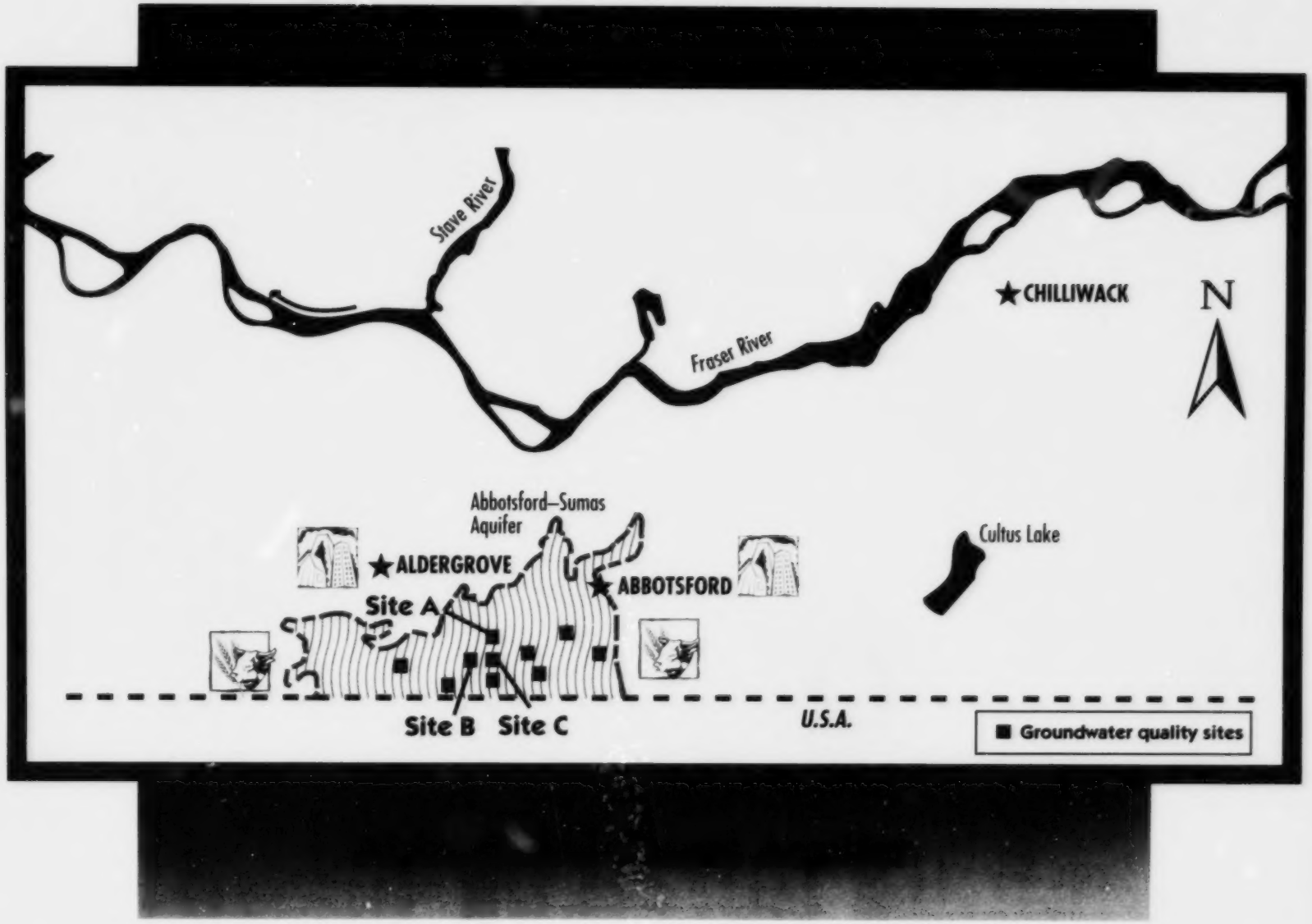
consume the aquatic life, have been substantially reduced in the Fraser River. For example, chlorinated phenols in the Fraser River at Hope were no longer detectable and met the objectives in 1995. Dioxins and furans in mountain whitefish muscle met the objective in 1995. The Ministry of Health lifted restrictions on the consumption of fish muscle in 1994. The AOX objective for the Fraser River was still not attained consistently at Hope in 1997, but this is considered to be of low environmental significance because chlorinated phenols and dioxins and furans met the objectives in 1995. AOX is merely a surrogate indicator for these chlorinated compounds.

Are there any other water quality concerns?

Fecal coliforms probably did not meet the water quality objective to protect raw drinking water that will receive partial treatment and disinfection, although the safe level for recreation was probably met. (Monitoring was not frequent enough to be certain whether the objectives were met or not met.) Exceeding the objective is not of immediate concern because the Fraser near Hope is not used for drinking water at present, but increased monitoring is needed to assess the attainment of the fecal coliform objectives more accurately. The 1996 B.C. Water Quality Status Report rated the river at Hope and downstream as good. Additional information on environmental quality in the lower Fraser River watershed is available in the Environment Canada report, Health of the Fraser River Aquatic Ecosystem – A Synthesis of Research Conducted under the Fraser River Action Plan.

What is being done to improve water quality?

Monitoring of the Fraser River at Hope is continuing, including fecal coliforms and AOX, to check the attainment of objectives and to track trends.


Stave River
Fraser River
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N
Abbotsford–Sumas
Aquifer
ALDERGROVE
ABBOTSFORD
Site A
Site B
Site C
Cultus Lake
U.S.A.
Groundwater quality sites

Abbotsford-Sumas Aquifer

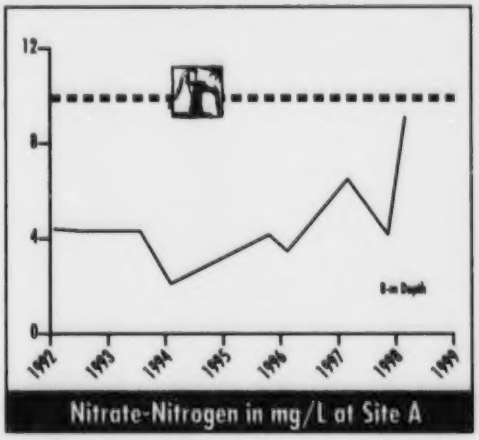
What are the water quality trends?

The nitrate levels at about 84% of the wells in the Abbotsford-Sumas Aquifer showed no changes or improving trends, but about 16% showed deteriorating trends. The drinking water guideline for nitrate was exceeded in 9 of 19 wells.

Improving Trends – 5 wells

No Changes – 11 wells

Deteriorating Trends – 3 wells



Nitrate-Nitrogen in mg/L at Site A

Example site showing a deteriorating trend.

What are the main attributes of the Abbotsford-Sumas Aquifer?

This aquifer straddles the international boundary just south from the City of Abbotsford. It is the largest and most extensively used aquifer in the Lower Mainland and is highly vulnerable to contamination. It is an important source of water for domestic use, municipal use, irrigation, industry, livestock watering, and a major trout hatchery.

What are the main human influences on water quality?

These include agriculture (manure and chemical fertilizers), industry, commercial activities and septic systems. There are also an airport, two landfills and potential contaminants, such as gasoline and pesticides, which can contaminate local groundwaters through leaks, spills or misuse.

What water quality indicators were monitored?

Nutrients, including nitrate, major ions, trace elements, dissolved solids, and temperature were monitored since 1988. Only data from wells in the Canadian portion of the aquifer monitored by the Ministry of Environment, Lands and Parks were examined. Environment Canada has also monitored the water quality of the aquifer, and the results are available from Environment Canada.

What are the water quality trends in the Abbotsford-Sumas Aquifer?

There are 19 active groundwater monitoring wells at 10 sites with sufficient data (greater than five years) to assess water quality trends. For nitrate, five wells show improving trends, three wells show deteriorating trends, and eleven wells show no changes.

The graph for Site A shows that nitrate levels at the 8–m depth were increasing (deteriorating trend) and approaching the drinking water guideline of 10 mg/L. Data collected between 1988 and 1991 were from bailed samples and not pumped, and therefore are suspect and have been omitted. The data since 1994 show strong evidence of a deteriorating trend. The causes of the observed trend need to be investigated.

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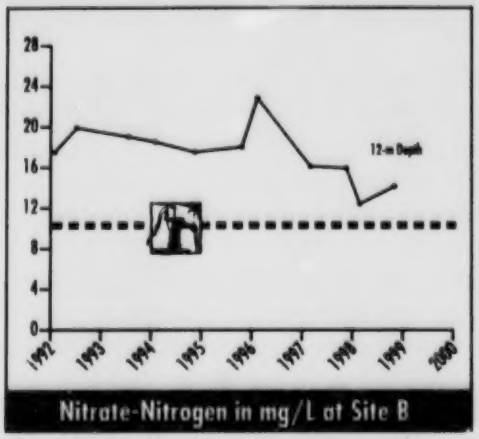
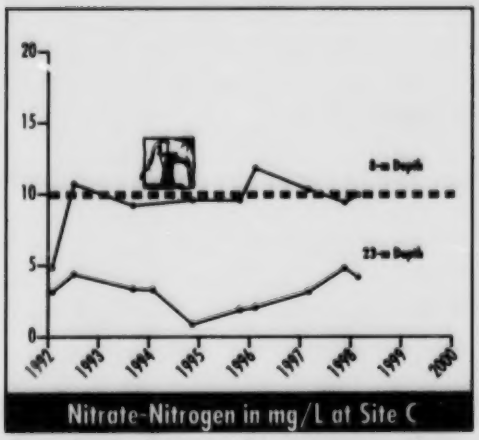


Example site showing an improving trend.



Example site showing a deteriorating trend at 8-m depth, and no change at 23-m depth.

The graph for Site B shows nitrate levels at the 12-m depth were decreasing (improving trend) and approaching, but still above, the 10 mg/L drinking water guideline.

The graph for Site C shows that nitrate levels decreased with depth at Site C, indicating that the nitrate was from surface sources. Nitrate levels at the 23–m depth showed no change and remained below the drinking water guideline. Nitrate levels at the 8–m depth remained near or above the drinking water guideline, but there was an increasing (deteriorating) trend.

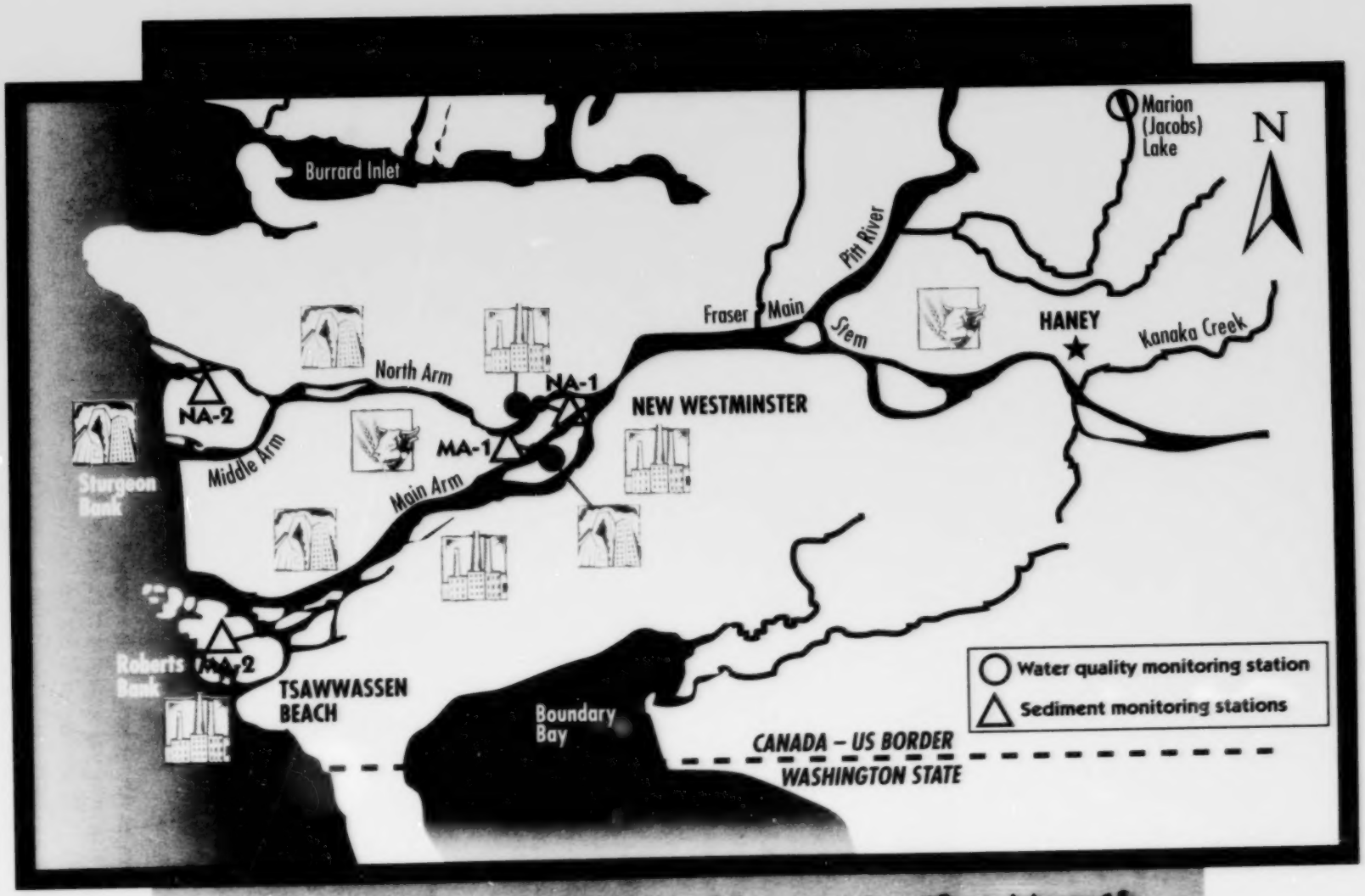
It is important to note that each well provides information on water quality at a specific point in the aquifer. Results at each well are affected by land use and natural factors at or near and directly up-gradient of the well, and are not representative of the entire aquifer.

What is the environmental significance of the trends?

The nitrate levels in localized portions of the aquifer were elevated with some well water exceeding the drinking water guideline. Nine of the 19 active groundwater monitoring wells were recently exceeding the 10 mg/L drinking water guideline for nitrate nitrogen. The 1996 B.C. Water Quality Status Report rated the Abbotsford-Sumas Aquifer as fair because of the elevated nitrate levels. Bottle-fed infants less than six months of age could be at risk of developing methaemoglobinaemia if the well water was used in the preparation of their infant formula. The nitrate/nitrite combines with the haemoglobin in the infant's blood and hinders the transfer of oxygen, preventing oxygen from getting to the body.

What will be done to improve water quality?

The City of Abbotsford has established the Abbotsford-Sumas Aquifer Stakeholder Group to develop a protection plan for the portion of the aquifer in B.C. Initiatives include enhancing public information and awareness, and improving land-use management practices over the aquifer. Better control of agricultural wastes being applied to farmland will help improve water quality. Residents can help by minimizing their use of fertilizers and pesticides. An International Task Force comprised of federal, provincial, and state agencies and local governments has been established to examine water quality concerns on both sides of the border and has made recommendations to improve the situation. The Ministry and Environment Canada will continue to monitor the groundwater quality of this aquifer on a coordinated basis, and will continue to encourage the local community to develop well and aquifer protection plans to protect their aquifer.



Fraser River Area from Haney to the Mouth

Marion (Jacobs) Lake

What are the water quality trends?
There were no environmentally significant changes.

No changes

What are the main attributes of Marion Lake?

Marion Lake is a small lake, draining 6.5 km^2 of the University of B.C. Research Forest in the headwaters of the North Alouette River east of Pitt Lake. The lake has low biological productivity because of its high water flushing rate. It is one of six highly sensitive lakes in southwestern B.C. monitored to determine if there were any measurable effects due to acidic inputs from the atmosphere (e.g., acid rain, snow and dustfall). The lake is acid-sensitive because it has a small watershed, the land and water have a relatively low capacity to absorb acids, and the acidic inputs from the atmosphere are the highest in B.C.

What are the main human influences on water quality?

Inputs of acids and other contaminants from the atmosphere carried by rain, snow and dustfall are the main human influences on water quality.

What water quality indicators were monitored?

Lake water was analysed once every month during 1985-94 for major ions, trace metals, nutrients, pH, alkalinity, hardness, dissolved and suspended solids, and colour. Phytoplankton and zooplankton (tiny aquatic plants and animals) were sampled once per month from May to October during 1984-93 to determine the numbers and kinds of plants and animals present. The large plants in the lake were surveyed in 1984 and 1989.

What are the water quality trends and what caused them?

There were no environmentally significant changes from 1984 to 1994.

Are there any other water quality concerns?

No. The water quality of Marion Lake was not evaluated in the 1996 B.C. Water Quality Status Report.

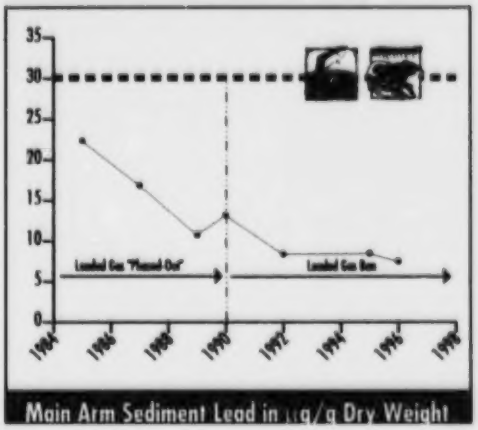
Does anything need to be done?

No. Monitoring was suspended at the end of 1994 because no significant changes or other concerns were evident. A 10-year baseline of data has been collected, which can be used to check for changes in the future if there are concerns about acidification or some other environmental issue.

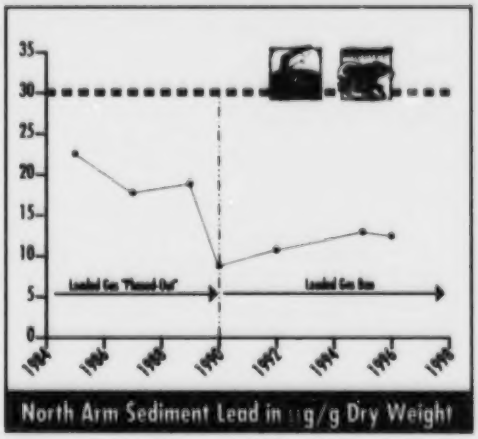
What are the sediment quality trends?

The lower Fraser River bottom sediments had improving trends in lead due to the phased reduction and ban of leaded gasoline.

Improving trends



Main Arm Sediment Lead in µg/g Dry Weight



North Arm Sediment Lead in µg/g Dry Weight

What are the main attributes of the lower Fraser River?

The Fraser River is one of B.C.'s most valued ecosystems, draining one-quarter of the province to Georgia Strait. Its drainage area in the lower reaches near the Strait of Georgia is over 232,000 km^2. The lower river is used for industrial water supply, irrigation, conservation, and recreation. It supports massive runs of all five species of Pacific salmon, as well as numerous species of resident fish. The Fraser River is a B.C. and Canadian Heritage River.

What are the main human influences on water and sediment quality?

These include treated effluents from pulp mills at Prince George, Quesnel and Kamloops, treated municipal sewage effluents from Prince George, Quesnel, Williams Lake, Kamloops, and Greater Vancouver, and non-point sources of pollution from agriculture, forestry, and urban areas. Air pollutants that settle on the land and water are suspected of being a significant source of some contaminants, especially in Greater Vancouver and the Lower Fraser Valley. The urban runoff from the Greater Vancouver area was particularly important with respect to lead from the combustion of leaded gasoline.

What sediment quality indicators were monitored?

Twelve trace elements, chlorinated phenols, polychlorinated biphenyls (PCBs), carbon, and particle size were monitored in the bottom sediments of two stations on each of the Main Arm of the Fraser River and the North Arm. Samples were collected every one to three years over the 12 years from 1985 to 1996.

What were the water quality trends and what caused them?

There were declining levels of lead in the bottom sediments of both the Main and North arms of the lower Fraser River due to the phased reduction of lead in gasoline during the 1980's and the ban of leaded gasoline in 1990. The decline in the Main Arm is statistically significant, but the apparent decline in the North Arm is not.

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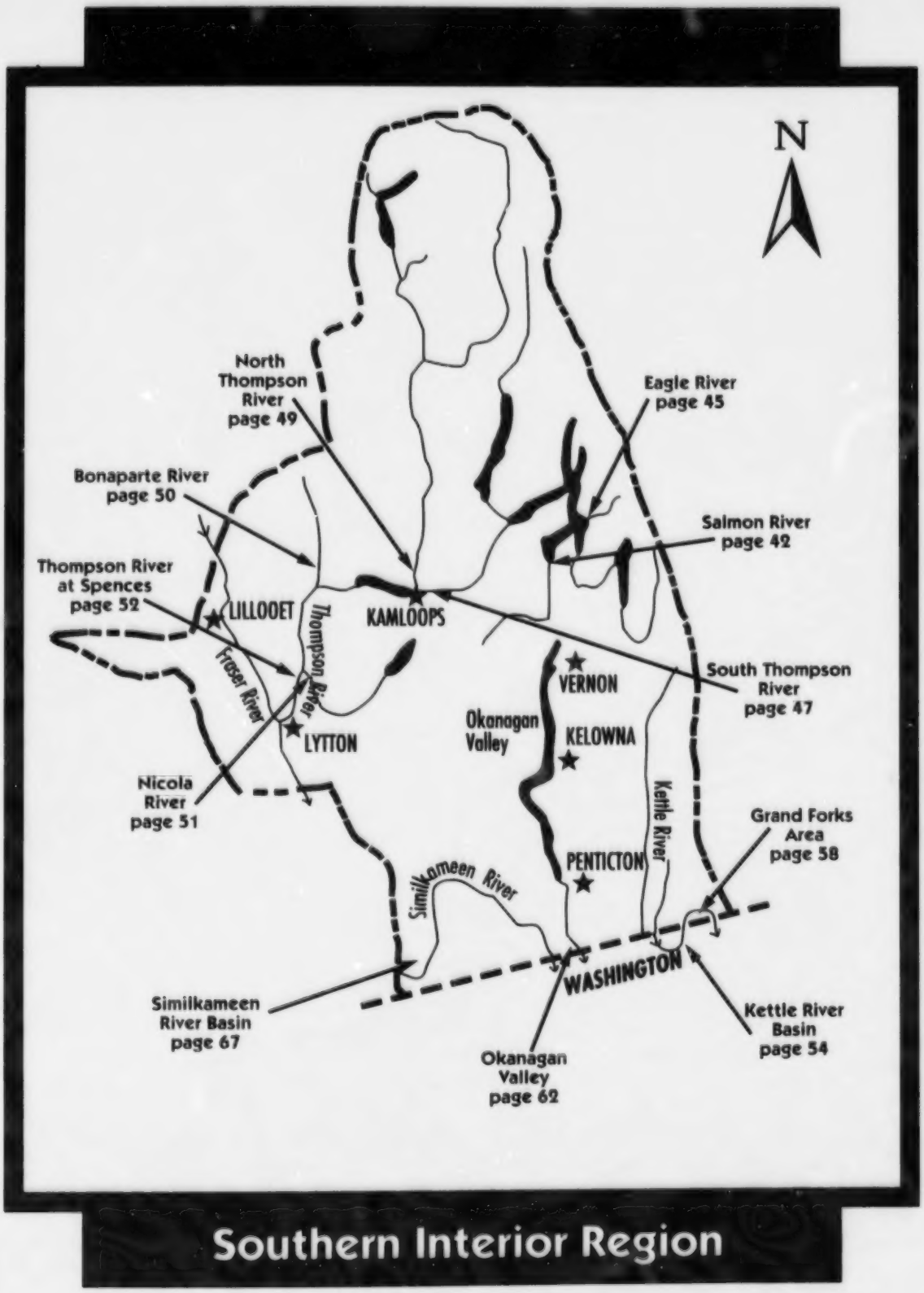
What is the environmental significance of the trends? The 1985 lead levels in the Fraser River bottom sediments were close to the guideline to protect aquatic life and wildlife, but have now declined to levels that are well below the guideline. The water quality of the Main and North Arms was rated fair in the 1996 B.C. Water Quality Status Report. Additional information on environmental quality in the lower Fraser River watershed is available in the Environment Canada report, Health of the Fraser River Aquatic Ecosystem – A Synthesis of Research Conducted under the Fraser River Action Plan.

What is being done to maintain sediment quality? The ban on leaded gasoline remains in place and the sediments of the lower Fraser River continue to be monitored periodically for a wide range of potential pollutants. The Greater Vancouver Regional District (GVRD) is preparing a Liquid Waste Management Plan to determine the effects of their discharges (combined sewer overflows, storm sewers, and sewage treatment plants) on water and sediment quality and plan necessary improvements. The GVRD has upgraded their sewage treatment plants to enhanced primary treatment, or secondary treatment. Waste Management permits require monitoring to be done for contaminants that could impair sediment and water quality.



Southern Interior Region

SOUTHERN INTERIOR REGION SUMMARY

The Southern Interior Region is located in the middle southern part of the Province, bordering Washington State. It extends from the Kettle River in the east to the Fraser River in the west, as shown on the map opposite. The Thompson River watershed occupies the northern portion of the Region, draining to the Fraser River at Lytton. The Similkameen, Okanagan, and Kettle river watersheds occupy the southern portion of the Region, all draining to the Columbia River in Washington State. The main BC Environment regional offices are located in Kamloops and Penticton.

Fifteen stream water quality stations and three groundwater aquifers were monitored over the long-term in this Region. There were seven stream stations in the Thompson River basin, four stream stations and one aquifer in the Kettle River basin, one stream station and two aquifers in the Okanagan River basin, and three stream stations in the Similkameen River basin. The water quality trends in these waterbodies are summarized in the table below.

If you have any questions on the trend reports or want more information on other waterbodies in the Region, please contact:

For the Thompson-Fraser river basins

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Deteriorating Trends in Water Quality

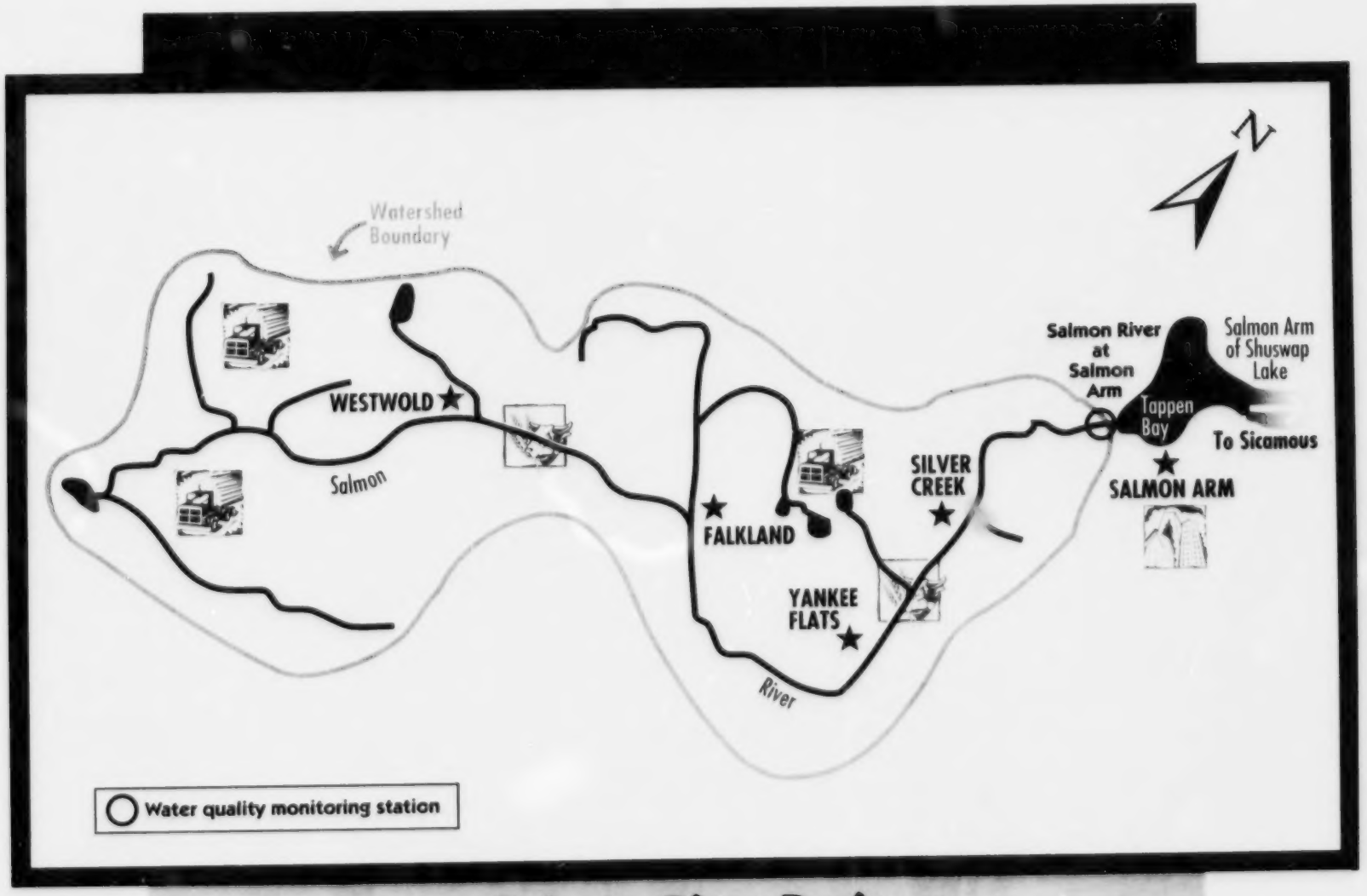
Location (Years)	Water Quality Indicators	Cause of Trend	Water Uses at Risk	Action
Salmon River at Salmon Arm (1988–97)	Turbidity	Agricultural and forestry non-point sources	Aquatic life and recreation	Continued abatement and monitoring.
South Thompson River at Kamloops (1987–97)	Suspended solids	Agricultural, forestry and residential non-point sources	Drinking water, aquatic life and recreation	Continued abatement and monitoring. Alternate drinking water sources and treatment options are being evaluated.
Grand Forks Aquifer – 4 of 16 wells (1991–98)	Nitrate	Agricultural and residential non-point sources	Drinking water	Continued abatement, monitoring and development of an aquifer protection plan.
Osoyoos Aquifers – 5 of 23 wells (1992–97)	Nitrate	Agricultural and residential non-point sources	Drinking water	Continued abatement and monitoring.

Improving Trends in Water Quality

Location (Years)	Water Quality Indicators	Cause of Trend	Water Uses at Risk	Action
Salmon River at Salmon Arm (1985–97)	Fecal coliforms	Agricultural non-point source abatement	Recreation, irrigation and livestock watering	Continued abatement and monitoring.
Thompson River at Spences Bridge (1985–97)	Chloride (indicator of chlorinated organics)	Pulp mill waste abatement	Aquatic life	Continued abatement and monitoring.
Grand Forks Aquifer – 3 of 16 wells (1991–98)	Nitrate	Agricultural and residential non-point source abatement	Drinking water	Continued abatement and monitoring.
Osoyoos Aquifers – 8 of 23 wells (1992–97)	Nitrate	Agricultural and residential non-point source abatement	Drinking water	Continued abatement and monitoring.
Similkameen River near US Border (1979–97)	Arsenic	Unknown	Aquatic life and drinking water	Continued monitoring.

No Changes in Water Quality – Other Water Quality Concerns

Location (Years)	Water Quality Indicators	Concern	Water Uses at Risk	Action
Salmon River at Salmon Arm (1988–97)	Phosphorus Water temperature	Elevated loadings to Shuswap Lake High in summer	Recreation Aquatic life	Continued abatement and monitoring.
Eagle River at Solsqua Road (1985–95)	Suspended solids, turbidity	Riverbank erosion	Aquatic life	Will be considered for watershed restoration.
North Thompson River at North Kamloops (1987–96)	Fecal coliforms	Exceeded objective at times	Drinking water	Monitoring is continuing and the applicability of the objective will be re-evaluated.
Bonaparte River near mouth (1986–95)	Fecal coliforms, turbidity, suspended solids, algae	Agricultural non-point sources of pollution and sewage treatment plant effluents	Aquatic life, drinking water recreation, irrigation, livestock watering	Remediation of non-point sources is continuing and sewage treatment plants have been upgraded.
Nicola River at Spences Bridge (1992–97)	Phosphorus	Agricultural non-point sources of pollution	Aquatic life	Remediation of non-point sources is being encouraged. Monitoring is continuing.
Kettle River at Midway (1980–95)		None at present		Monitoring is continuing.
Boundary Creek at Midway (1980–94)		None		None needed.
Kettle River at Carson (1980–95)		None at present		Monitoring is continuing.
Grand Forks Aquifer – 9 wells of 16 (1991–98)	Nitrate	Elevated levels	Drinking water	Continued monitoring.
Kettle River at Gilpin (1980–95)		None		Monitoring is continuing at Midway and Carson.
Okanagan River at Oliver (1980–95)	Water temperature	High in summer	Coldwater aquatic life	Monitoring is continuing.
Osoyoos Aquifers – 10 wells of 23 (1992–97)	Nitrate	Elevated levels	Drinking water	Continued monitoring.
Similkameen River at Princeton (1989–97)		None		Monitoring is continuing.
Similkameen River above Hedley (1989–97)		None		Monitoring is continuing at Princeton & near US border.



Salmon River Basin

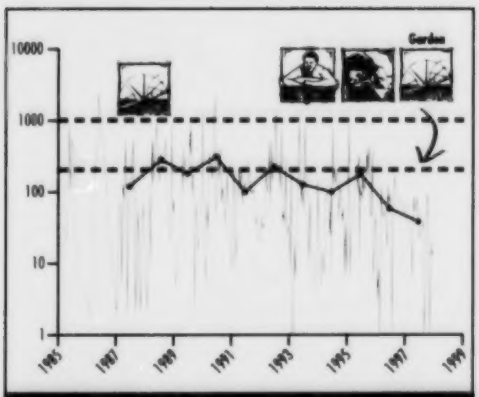
Salmon River at Salmon Arm

What are the water quality trends?

There was an improving trend in fecal coliforms but a deteriorating trend for turbidity.

Improving trend – 1

Deteriorating trend – 1



Fecal Coliforms per 100 mL

What are the main attributes of the Salmon River?

The Salmon River at Salmon Arm drains 1,510 km^2 of the Interior Plateau to Tappen Bay on the Salmon Arm of Shuswap Lake at the District of Salmon Arm. The river is heavily used for irrigation, including lawns and gardens, and livestock watering, and has significant habitat for the spawning and rearing of salmonids and other fish species.

What are the main human influences on water quality?

These include widespread non-point sources of pollution from agriculture, forestry, transportation (roads and railway), and some residential development at Westwold, Falkland, Silver Creek, Yankee Flats, and Salmon Arm.

What water quality indicators were monitored?

Major ions, trace elements, nutrients, colour, dissolved and suspended solids, pH, fecal coliforms and temperature have been monitored once every two weeks since 1988 (monthly monitoring of fecal coliforms, nutrients and solids was also done during 1985-87) at the old Highway #1 bridge near the mouth of the Salmon River. Flow has been monitored continuously at the same location.

What are the water quality trends and what caused them?

There was a declining trend in fecal coliforms and an increasing trend in turbidity, possibly due to changes in the non-point sources of pollution in the watershed. Restriction of manure application on snow-covered fields and the installation of fences to keep livestock out of streams probably contributed to the decline in fecal coliforms. Water temperature showed no change, while total and dissolved phosphorus, magnesium, potassium and sodium had weak and/or contradictory evidence of increasing trends.

What is the environmental significance of the trends?

The decrease in fecal coliforms made the water safer for recreation, irrigation and livestock watering. The guidelines for these water uses have not been exceeded since mid–1995. However, the increase in turbidity made the water less suitable for recreation and aquatic life.

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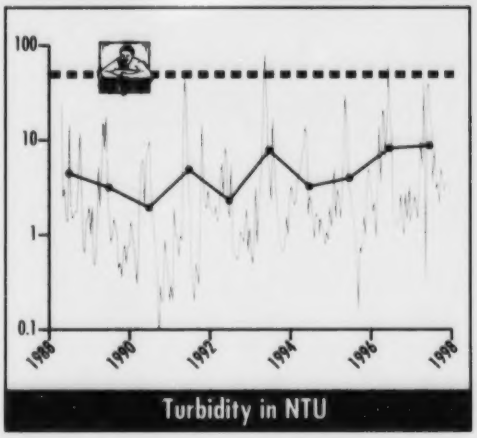
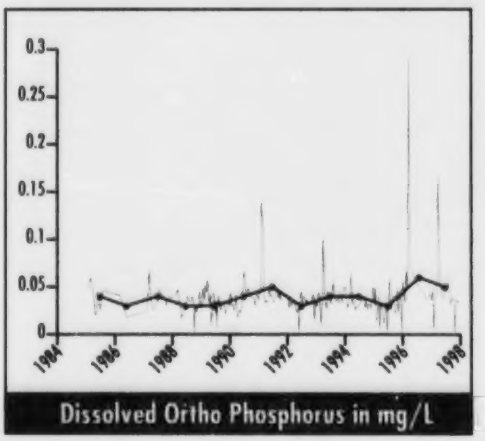
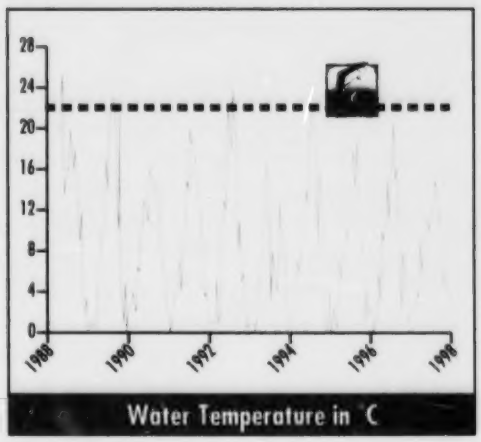
Are there any other water quality concerns?

Elevated turbidity and phosphorus loadings to Shuswap Lake arising from agricultural and forestry non-point sources, and low flows and high water temperatures in summer are the main water quality concerns for the Salmon River as shown in the plots. Salmon River water quality was not evaluated in the 1996 B.C. Water Quality Status Report. Additional information on environmental quality in the Salmon River watershed is available in the Environment Canada report, Health of the Fraser River Aquatic Ecosystem – A Synthesis of Research Conducted under the Fraser River Action Plan.

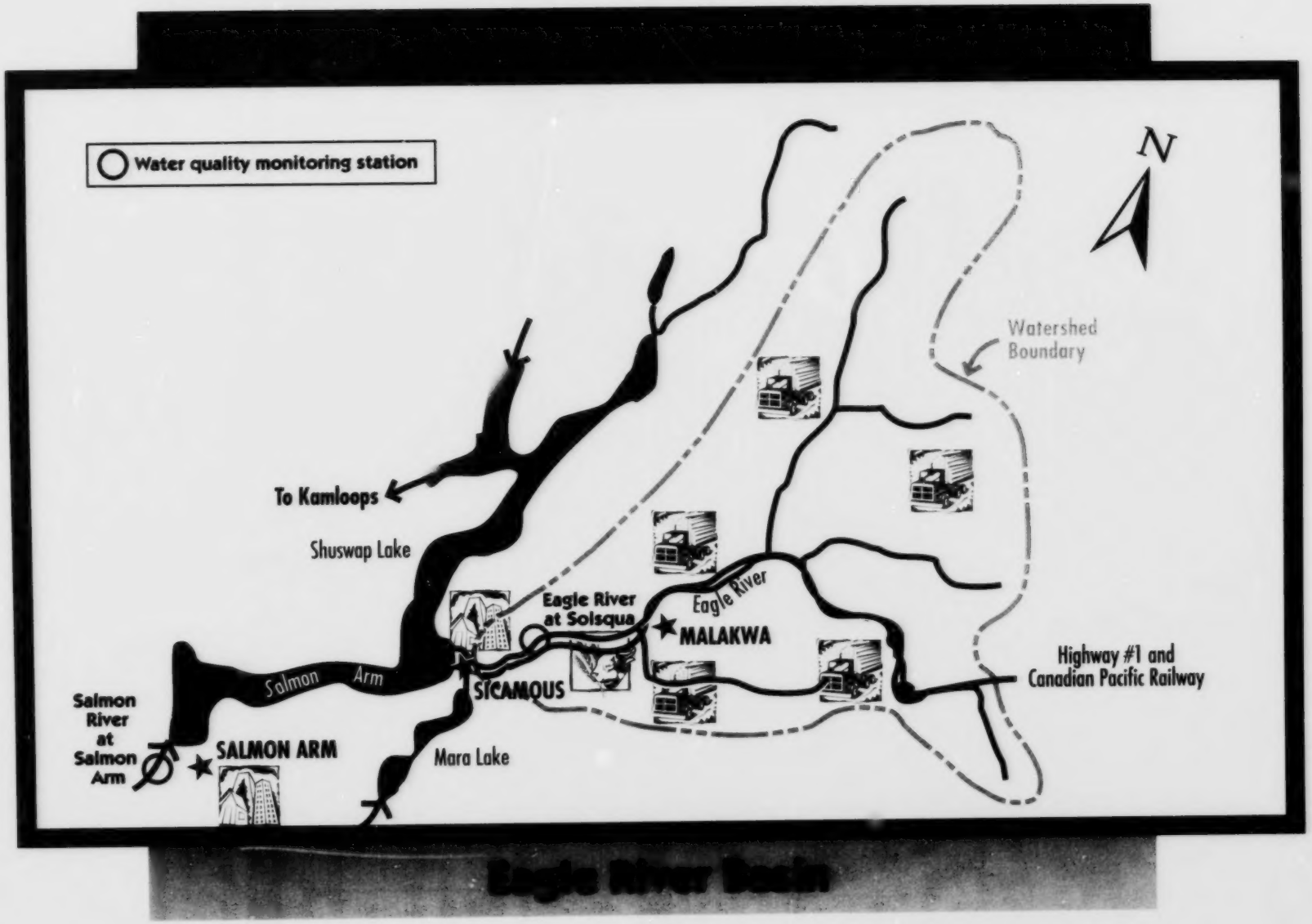






What is being done to improve matters?

The Salmon River Watershed Roundtable is coordinating a host of remedial measures to reduce non-point source pollution from agriculture and forestry, including public education. Also, eroding river banks are being stabilized, revegetated, and fenced to protect them from livestock, in cooperation with Fisheries and Oceans Canada. BC Environment is continuing to work with farmers and ranchers to reduce pollution from agricultural sources. Monitoring of the Salmon River at Salmon Arm by BC Environment and Environment Canada is continuing in order to track trends in water quality, including the effects of the 1998 Silver Creek fire and efforts to rehabilitate the burned area.



Eagle River Basin

Eagle River at Solsqua Road

What are the water quality trends?
There were no environmentally significant changes.

No changes

What are the main attributes of the Eagle River?

The Eagle River drains about 1,230 km^2 of the Monashee Mountains to Shuswap Lake at Sicamous. The river is used for irrigation, livestock watering, and drinking water, and has significant habitat for spawning and rearing of salmonids and other fish species.

What are the main human influences on water quality?

Highway #1 and the Canadian Pacific Railway follow the Eagle River from the headwaters to the mouth. There is some agriculture in the lower 15 km of the valley, and forestry throughout the watershed. The Village of Sicamous is located at the mouth of the river, and installed a tertiary sewage treatment plant with discharge to the ground adjacent to the river in 1995, replacing many on-site sewage systems.

What water quality indicators were monitored?

Major ions (chloride and sulphate), nutrients, dissolved and suspended solids, pH, and fecal coliforms were monitored approximately once a month from 1985 to 1995 at the Solsqua Road bridge. Flow has been monitored continuously near Malakwa, about 12 km upstream from the water quality station.

What are the water quality trends and what caused them?

There were no environmentally significant changes from 1985 to 1995.

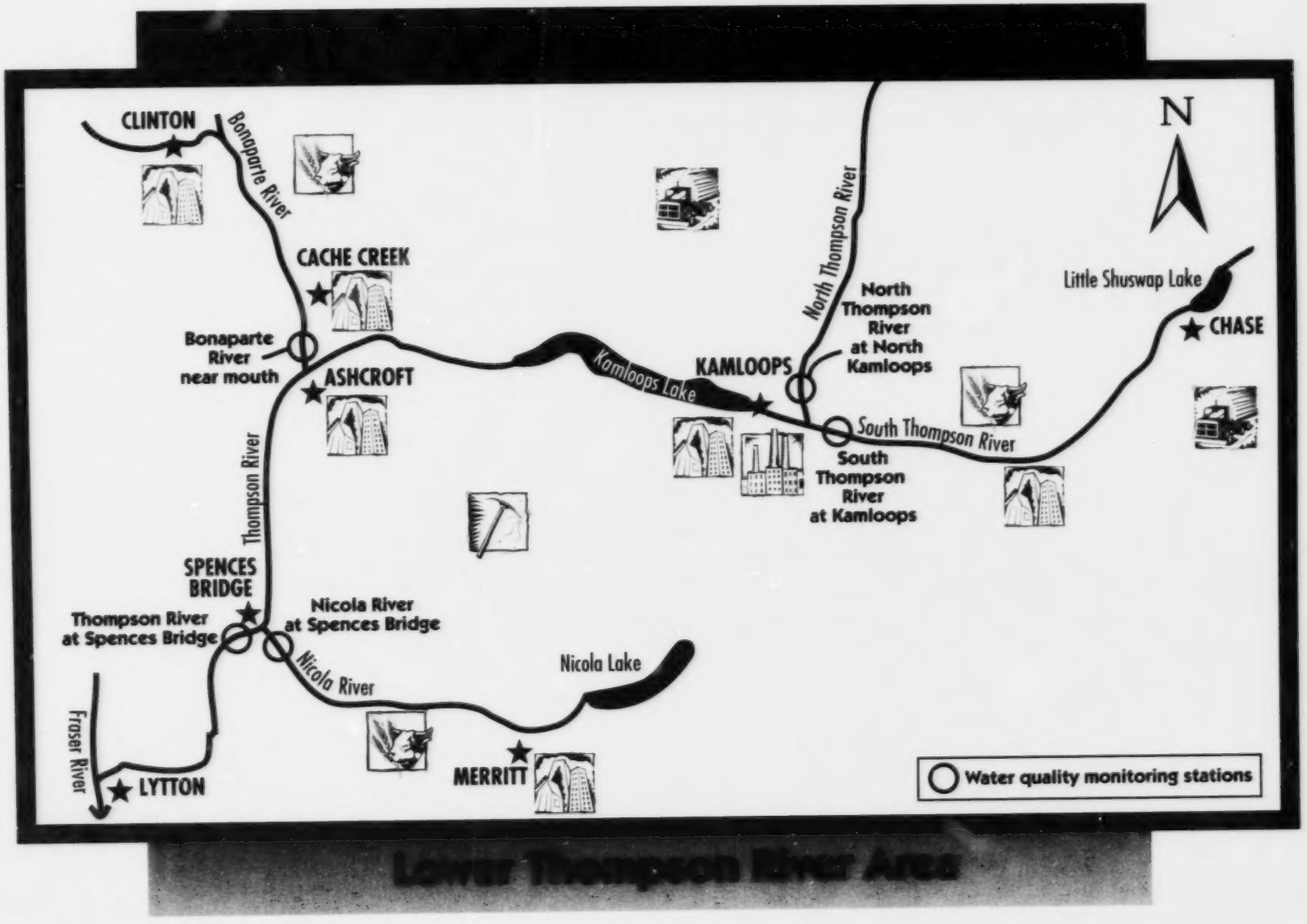
Are there any other water quality concerns?

Additional monitoring of the Eagle River downstream from the new sewage treatment plant of Sicamous may be needed. Some river banks downstream from Malakwa have suffered from erosion and would benefit from bank reclamation, such as revegetation and stabilization methods such as tree revetments (retaining walls).

The water quality of the Eagle River was not evaluated in the 1996 B.C. Water Quality Status Report.

Does anything need to be done?

There were no environmentally significant changes and regular monitoring was suspended in early 1995. Monitoring will be done downstream from the Sicamous sewage treatment plant if needed. The Eagle River will be considered for watershed restoration to control bank erosion.

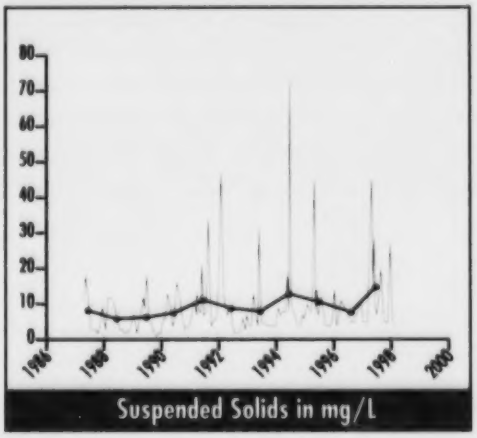


Lower Thompson River Area

South Thompson River at Kamloops

What are the water quality trends?
There was a deteriorating trend in suspended solids due to non-point sources of pollution.

Deteriorating trend



Suspended Solids in mg/L

What are the main attributes of the South Thompson River?

The South Thompson River drains about 17,000 km^2 of the Columbia Mountains and Shuswap Highlands, joining the North Thompson River at Kamloops. The river is used for drinking water (Kamloops and Chase), irrigation, livestock watering, industrial water supply, and recreation. It is a migration route for the Adams River salmon run and several other smaller sockeye, coho and chinook salmon runs, and is an important habitat for bull trout, squawfish, rainbow trout, and Rocky Mountain whitefish.

What are the main human influences on water quality?

These include non-point source discharges from agriculture, forestry, and residential, commercial, and industrial development. Many storm sewers draining areas of the City of Kamloops enter the South Thompson River upstream from the monitoring station. Several tributary streams such as Chase Creek and Stobart Creek have sustained substantial damage to their banks and are major sources of turbidity and suspended solids. Point source waste water discharges consist of industrial cooling water and have only a minor effect on water quality.

What water quality indicators were monitored?

Chloride, nutrients, dissolved and suspended solids, pH, and fecal coliforms have been measured monthly since 1987 (and sporadically from 1975 to 1987). A wide variety of other characteristics were also measured periodically between 1975 and 1996. Flow has been measured continuously at Chase, about 60 km upstream, where the drainage area is 16,200 km^2.

What are the water quality changes and what caused them?

There was an increasing trend in suspended solids during 1987–97 due to non-point sources of pollution such as agriculture, forestry and residential development. Major erosion in tributary streams is the main cause of the increasing trend.

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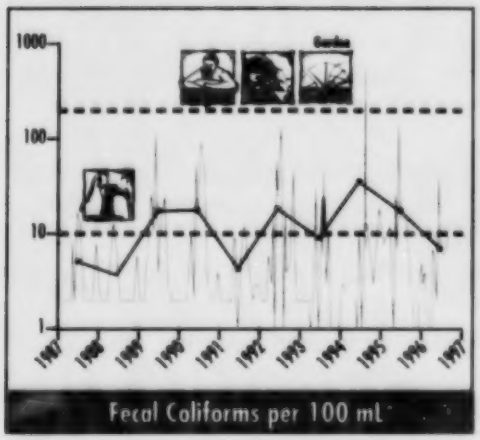


What is the environmental significance of the trend?

Suspended solids (and other water quality indicators) were elevated to the extent that Regional Health authorities have required the City of Kamloops to provide potable drinking water by April 1, 2003. To achieve this, the City is considering alternate water sources or providing full treatment of the South Thompson River source. The suspended solids also made the water less suitable for aquatic life and recreation.

Are there any other water quality concerns?

The objective for fecal coliforms to protect raw drinking water that will receive only disinfection was exceeded. The water quality of the South Thompson River was not evaluated in the 1996 B.C. Water Quality Status Report. Additional information on environmental quality in the South Thompson River watershed is available in the Environment Canada report, Health of the Fraser River Aquatic Ecosystem – A Synthesis of Research Conducted under the Fraser River Action Plan.

What is being done? A roundtable, including representatives from the City of Kamloops, the Thompson-Nicola Regional District, Fisheries and Oceans Canada, BC Environment, the Ministry of Agriculture and Food, First Nations, industry, environmental groups, and the public has been established to work to improve the water quality of the South Thompson River. BC Environment is cooperating with the City, the Regional District, the Ministry of Transportation and Highways, Forest Renewal BC, and landowners to control non-point source pollution in the watershed. For example, a study was completed on sediment sources such as Chase and Stobart creeks, and the channel of Chase Creek is being restored with funding from Forest Renewal BC. The City and Transportation and Highways are treating stormwater and reducing non-point source pollution from new developments. The Regional District is preparing a Regional Growth Strategy, and is restricting development in the valley upstream from Kamloops to reduce urban sprawl and to protect the City's water supply. To reduce pollution from residential areas, the Regional District has sewered the Pritchard subdivision, while the City has sewered the Dallas and Barnhartvale subdivisions. Several farms have cooperated in fencing the river bank to keep livestock away. The City has hired an Environmental Youth Team to work on non-point source pollution, and is currently evaluating alternate drinking-water sources and various drinking water treatment options to remove turbidity and potential *Giardia* and *Cryptosporidium* contamination from the South Thompson River drinking water supply. BC Environment is continuing to monitor the South Thompson River at Kamloops and Chase Creek.

North Thompson River at North Kamloops

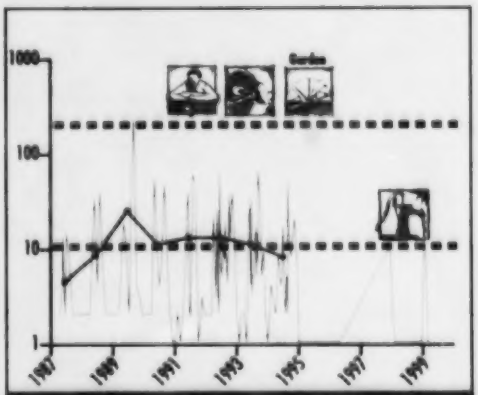
What are the water quality trends?
There were no environmentally significant changes.

No changes

What are the main attributes of the North Thompson River? The North Thompson River drains about 20,000 km^2 of the Interior Plateau, Shuswap Highlands, and Columbia Mountains north from Kamloops, joining the South Thompson River at Kamloops. The river is free-flowing, with no lakes on the main channel, and a large contribution to flow from glacier and snow melt. The river is used for drinking water, irrigation, livestock and wildlife watering, recreation, and industrial water supply, and supports important populations of aquatic life, including coho, chinook and sockeye salmon, rainbow trout, bull trout, whitefish, burbot and many non-game species.

What were the main human influences on water quality?
These include non-point sources such as forestry, urban development, transportation (Highway 5 and Canadian National Railway) and agriculture. There are no point source discharges directly to the river.

What water quality indicators were monitored?
Major ions (chloride and sulphate), nutrients, pH, dissolved and suspended solids, and fecal coliforms were measured monthly from 1987 to 1996 at North Kamloops, about 4 km upstream from the confluence with the South Thompson River. A wide variety of trace elements, major ions, colour, and turbidity were also measured periodically. Flow was measured continuously at McLure, about 40 km upstream from the water quality station.



Fecal Coliforms per 100 mL

What are the water quality trends and what caused them?
There were no environmentally significant changes from 1987 to 1996.

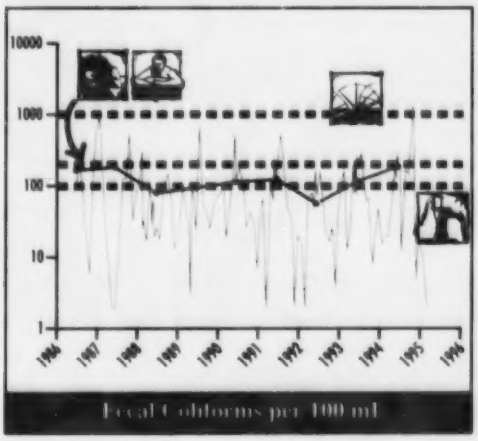
Are there any other water quality concerns?
The objective for fecal coliforms to protect raw drinking water that receives only disinfection was exceeded at times. However, the turbidity in the river was such that the water should be partially treated (e.g., settling, filtration) and disinfected before drinking. It may be that the fecal coliform objective is too stringent given the turbidity of the river. The water quality of the North Thompson River was not evaluated in the 1996 B.C. Water Quality Status Report. Additional information on environmental quality in the North Thompson River watershed is available in the Environment Canada report, Health of the Fraser River Aquatic Ecosystem – A Synthesis of Research Conducted under the Fraser River Action Plan.

What will be done?
Regular, year-round monitoring was suspended in early 1996, but monthly monitoring during winter low flows is continuing to check the attainment of the objectives. Fecal coliforms and turbidity will be monitored, and the applicability of the fecal coliform objective will be re-evaluated.

Bonaparte River

What are the water quality trends?
There were no environmentally significant changes.

No changes



Fecal Coliforms per 100 ml

What are the main attributes of the Bonaparte River?
The Bonaparte River drains 5,020 km^2 of the Interior Plateau to the Thompson River at Ashcroft. The river is important salmonid habitat and a major source of irrigation water. A fish ladder was installed in the canyon about 1.5 km upstream from the river's mouth to allow salmon and steelhead to reach the upper watershed.

What are the main human influences on water quality?
These include agriculture, forestry, transportation (Highway 97 and the BC Railway), and urban runoff and treated municipal sewage from Cache Creek and Clinton.

What water quality indicators were monitored?
Major ions (chloride and sulphate), nutrients, pH, dissolved and suspended solids, and fecal coliforms were measured about monthly from 1986 to 1995 near the mouth of the river. A wide variety of trace elements, major ions, colour, turbidity and algae were also measured periodically. Flow has been monitored continuously below Cache Creek, about 6 km upstream from the water quality station.

What are the water quality trends and what caused them?
There were no environmentally significant changes from 1986 to 1995, and regular monitoring was suspended in early 1995.

Are there any other water quality concerns?
The objectives for fecal coliforms, turbidity, suspended solids, and algae were regularly not met near the mouth of the river as noted in the 1996 B.C. Water Quality Status Report, which rated the water quality as fair. The fecal coliform measurements are shown on the graph.

What is being done to improve matters?
BC Environment, Fisheries and Oceans Canada, and landowners have cooperated to stabilize streambanks and to fence to keep livestock out of the Bonaparte River and its tributaries. BC Environment is working with farmers and ranchers to reduce their environmental impacts in accordance with the Code of Agricultural Practice for Waste Management. Through education, livestock producers are encouraged to become active stream stewards to rehabilitate streamside vegetation and banks to prevent erosion and provide shade. New subdivisions are being regulated to protect streamside vegetation and prevent erosion, and sewage treatment plants have been upgraded. Monitoring will resume after improvements are made.

Nicola River

What are the water quality trends?
There were no environmentally significant changes.

No changes

What are the main attributes of the Nicola River?

The Nicola River drains 7,280 km^2 of the Interior Plateau to the Thompson River near Spences Bridge. The river is used for irrigation, livestock watering, and drinking water, and is an important salmonid spawning and rearing habitat.

What are the main human influences on water quality?

These include agricultural operations, forestry, transportation, mining, and urban runoff and treated municipal sewage from Merritt.

What water quality indicators were monitored?

Major ions (chloride and sulphate), nutrients, dissolved and suspended solids, pH, and fecal coliforms have been monitored monthly since 1992 at the mouth of the river near Spences Bridge. Flow has been monitored continuously at this location.

What are the water quality trends and what caused them?

There were no environmentally significant changes from 1992 through 1997.

Are there any other water quality concerns?

Dissolved phosphorus levels in the Nicola River at the mouth were somewhat elevated, possibly due to agricultural non-point sources. The water quality of the Nicola River was not evaluated in the 1996 B.C. Water Quality Status Report. Additional information on environmental quality in the Nicola River watershed is available in the Environment Canada report, Health of the Fraser River Aquatic Ecosystem – A Synthesis of Research Conducted under the Fraser River Action Plan.

What is being done?

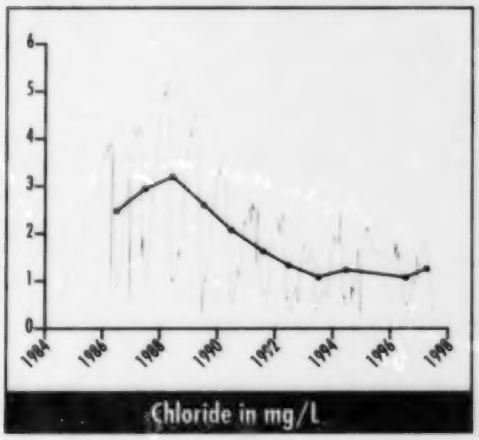
Agricultural producers are being encouraged to conform to the Agricultural Waste Management regulation and best management practices, and several stretches of the river are being restored. Monitoring is continuing on the Nicola River since six years is a relatively short time for the detection of long-term trends in water quality.

Thompson River at Spences Bridge

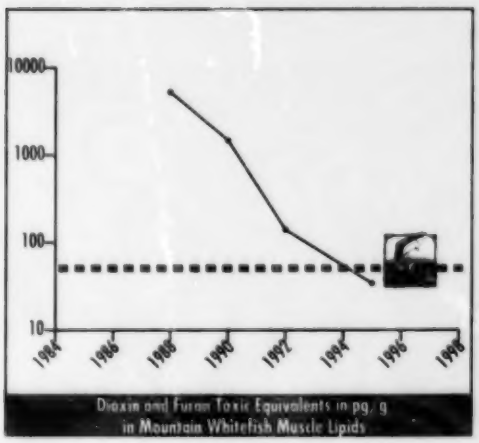
What are the water quality trends?

There was an improving trend in dissolved chloride, an indicator for chlorinated organics, due to waste abatement at the pulp mill in Kamloops.

Improving trend



Chloride in mg/L



Dioxin and Furan Toxic Equivalents in pg/g in Mountain Whitefish Muscle Lipids

What are the main attributes of the Thompson River?

The Thompson River drains over 55,000 km^2 of the Interior Plateau, Shuswap Highlands, and Columbia Mountains to the Fraser River at Lytton. The river is important for fish spawning and rearing, for migrating salmon, and for irrigation, livestock watering, drinking water, and recreation such as rafting and steelhead fishing.

What are the main human influences on water quality?

These include treated effluent from a bleached kraft pulp mill and the City of Kamloops sewage treatment plant discharge upstream from Kamloops Lake. Other small point sources include the Merritt, Clinton, Cache Creek and Ashcroft sewage treatment plant discharges. There are several large mines in the watershed, but only small amounts of seepage are discharged. There are also non-point source discharges from agriculture, urban development, forestry, transportation and streambank erosion.

What water quality indicators were monitored?

Major ions, trace elements, nutrients, colour, dissolved and suspended solids, pH, and temperature have been monitored once every two weeks at Spences Bridge since 1985. Flow has been monitored continuously at this location.

What are the water quality trends and what caused them?

Chloride declined from 1988 to 1993 due to the elimination of elemental chlorine in the pulp mill bleaching process.

What is the environmental significance of the trend?

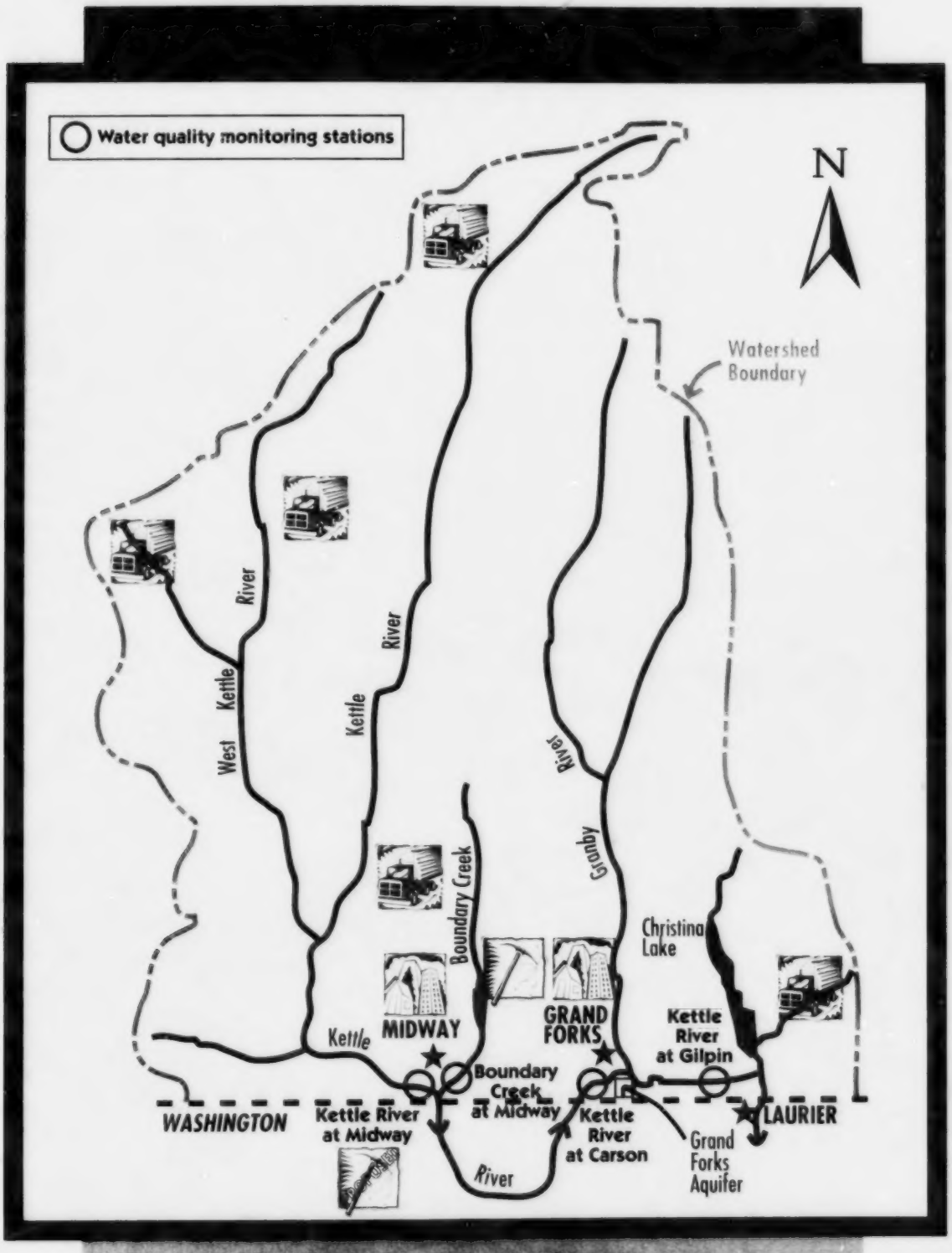
Chloride levels were well below all water quality guidelines. The significance of chloride in this situation is as an indicator of chlorinated organics, which can be toxic to aquatic life and to humans and wildlife that consume aquatic life. The decline in chloride indicates that chlorinated organics have been substantially reduced in the Thompson River. Indeed, the levels of the chlorinated organics, dioxins and furans, in fish have declined substantially during 1988–95 as shown on the graph opposite. Fish consumption advisories have been lifted by the Health authorities, and the objective to protect the fish themselves was attained in 1995.

Are there any other water quality concerns?

The water quality of the Thompson River was rated as fair in the 1996 B.C. Water Quality Status Report due to excessive growths of algae. Additional information on environmental quality in the Thompson River watershed is available in the Environment Canada report, Health of the Fraser River Aquatic Ecosystem – A Synthesis of Research Conducted under the Fraser River Action Plan.

What is being done?

The pulp mill continues to improve the quality of its effluent discharge through modernization projects. Non-point source programs to address agricultural, urban runoff and forestry pollution are continuing along with streambank restoration on impacted tributary streams. The City of Kamloops sewage treatment plant is being studied to determine what improvements will be required to modernize the plant and improve effluent quality. The Ashcroft sewage treatment plant will be upgraded to include disinfection and possibly phosphorus removal. Monitoring is continuing on the Thompson River at Spences Bridge.

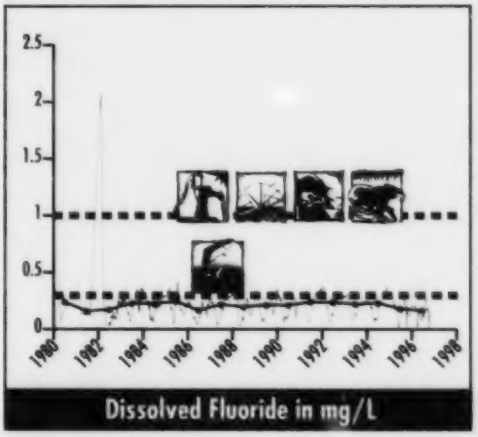


Kettle River Basin

Kettle River at Midway

What are the water quality trends?
There were no environmentally significant changes.

No changes



Dissolved Fluoride in mg/L

What are the main attributes of the Kettle River?
The Kettle River at Midway drains 5,157 km^2 of the Monashee Mountains and the Okanagan Highland. It is joined at Midway by Boundary Creek, which drains 593 km^2 of the Monashee Mountains, and together they flow into Washington State. The river is used for drinking, irrigation and industrial water supply, and supports several species of trout. The Kettle River upstream from Midway is a B.C. Heritage River.

What are the main human influences on water quality?
The main potential influences on water quality are forest harvesting, agriculture and treated sewage from the Village of Midway. The treated sewage is discharged downstream from the trend monitoring station, but other monitoring has shown that the discharge has no significant effect on the river.

What water quality indicators were monitored?
Major ions, trace elements, cyanide, nutrients, colour, dissolved and suspended solids, pH and temperature have been monitored once every two weeks since 1980 just upstream from Boundary Creek (Boundary Creek at Midway is discussed on the next page). Flow has been monitored continuously just downstream from Boundary Creek.

What are the water quality trends and what caused them?
There were no environmentally significant changes from 1980 to 1995.

Are there any other water quality concerns?
Fluoride levels in the Kettle River at Midway at times exceeded the guideline to protect aquatic life. However, the levels are naturally occurring and we are not aware of any effects on fish populations. The water quality of the Kettle River was not evaluated in the 1996 B.C. Water Quality Status Report.

Does anything need to be done?
There are no human-caused water quality changes or concerns that require action at this time, but monitoring is continuing on the Kettle River at Midway and Carson because of the development of the Battle Mountain Crown Jewel gold mine in Washington State, which drains to the Kettle River between these two stations.

Boundary Creek at Midway

What are the water quality trends?
There were no environmentally significant changes.

No changes

What are the main attributes of Boundary Creek?
Boundary Creek drains 593 km^2 of the Monashee Mountains and joins the Kettle River as it flows into Washington State at Midway. The creek is used for drinking and irrigation water supply, and supports several species of trout.

What are the main human influences on water quality?
The main potential influences on water quality are forest harvesting, treated sewage from the City of Greenwood, and drainage from old mines. The Greenwood discharge is to ground and not directly to the creek. Monitoring upstream and downstream from the discharge found no significant effect on the river.

What water quality indicators were monitored?
Major ions, trace elements, nutrients, colour, dissolved and suspended solids, pH and temperature were monitored about once every two months from 1980 to 1994 just upstream from the Kettle River (Kettle River at Midway is discussed on the previous page).

What are the water quality trends and what caused them?
There were no environmentally significant changes from 1980 to 1994.

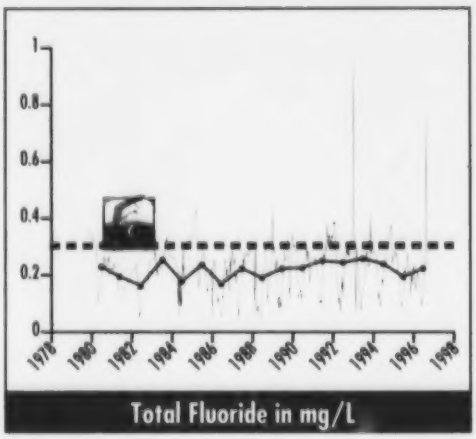
Are there any other water quality concerns?
No. The water quality of Boundary Creek was not evaluated in the 1996 B.C. Water Quality Status Report.

Does anything need to be done?
There were no water quality changes or concerns from 1980 to 1994, and monitoring was suspended in 1994.

Kettle River at Carson

What are the water quality trends?
There were no environmentally significant changes.

No changes



Total Fluoride in mg/L

What are the main attributes of the Kettle River?

The Kettle River drains 5,750 km^2 of the Monashee Mountains and the Okanagan Highland in B.C. south into Washington State at Midway. It then drains an additional 980 km^2 of the Monashee Mountains in northern Washington State before looping back into B.C. at Carson with a drainage area of 6,730 km^2. The river is used for drinking and irrigation water supply, and supports several species of trout.

What are the main human influences on water quality?

The main potential influences on water quality are forest harvesting, agriculture, treated sewage from the Village of Midway, and a proposed mine in Washington State.

What water quality indicators were monitored?

Major ions, trace elements, nutrients, colour, cyanide, dissolved and suspended solids, pH and temperature have been monitored once every two weeks since 1980 on the Kettle River at Carson. Flow has been measured continuously upstream near Midway (5,750 km^2) and downstream near Laurier (9,840 km^2).

What are the water quality trends and what caused them?

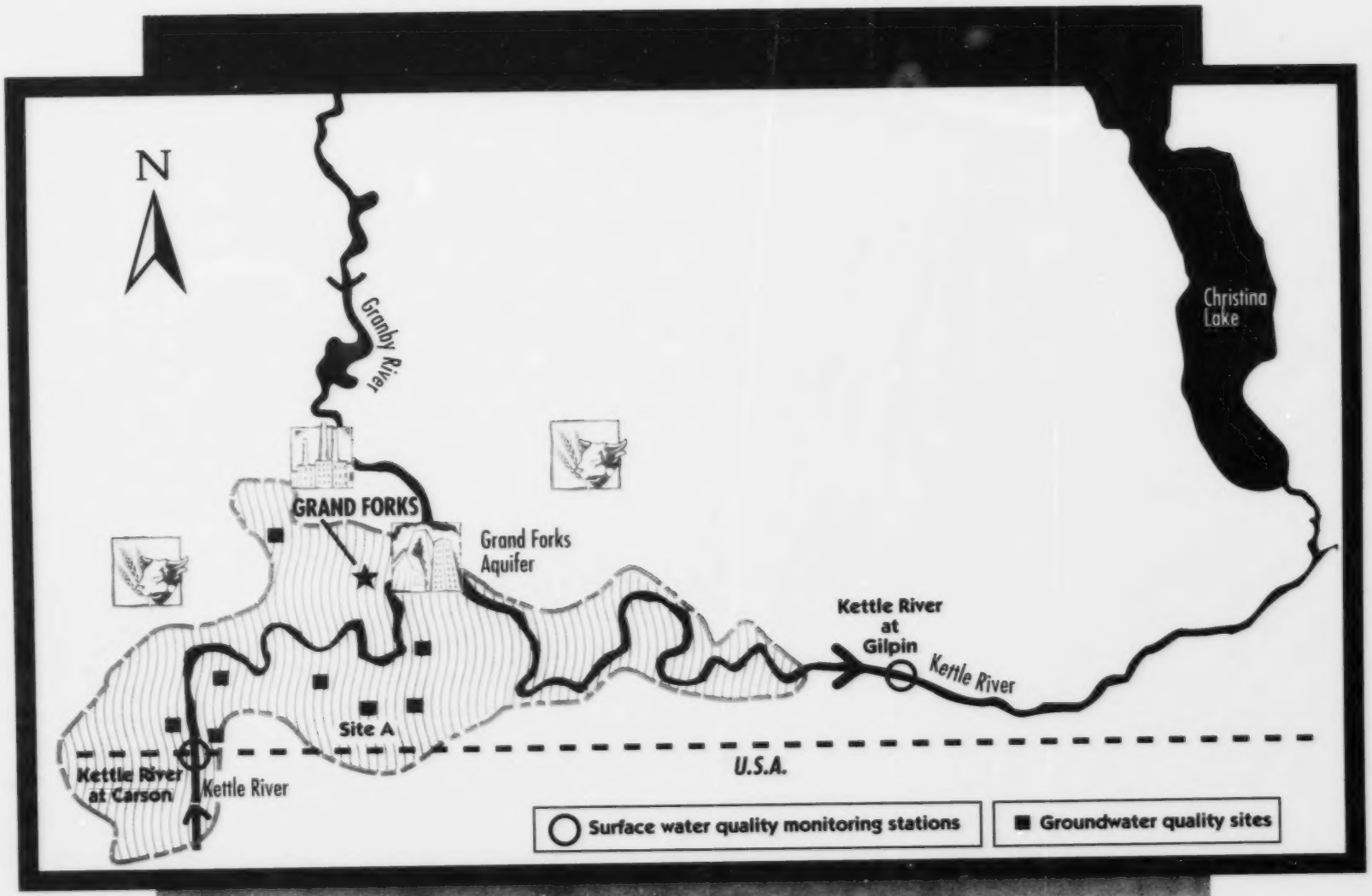
There were no environmentally significant changes from 1980 to 1995.

Are there any other water quality concerns?

Fluoride levels in the Kettle River at Carson at times exceeded the guideline to protect aquatic life. However, the levels are naturally occurring and similar to those measured upstream at Midway. We are not aware of any effects on fish populations. The water quality of the Kettle River was not evaluated in the 1996 B.C. Water Quality Status Report.

Does anything need to be done?

There are no human-caused water quality changes or concerns that require action at this time, but monitoring is continuing on the Kettle River at Midway and Carson because of the development of the Battle Mountain Crown Jewel gold mine in Washington State, which drains to the Kettle River between these two stations.



Grand Forks Area

Grand Forks Aquifer

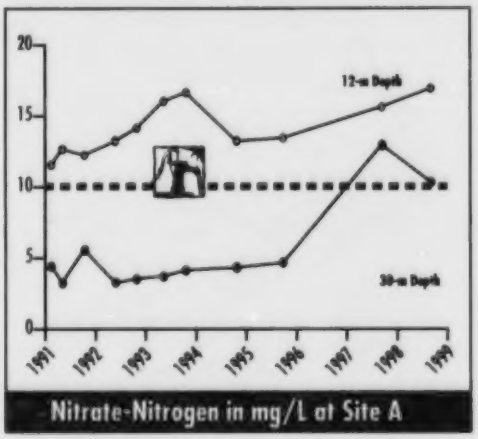
What are the water quality trends?

The nitrate levels at about one-half of the wells in the Grand Forks Aquifer showed no changes, but about one-quarter showed deteriorating trends and one-quarter showed improving trends. The drinking water guideline for nitrate was exceeded in 4 of 16 wells.

Improving Trends – 3 wells

No Changes – 9 wells

Deteriorating Trends – 4 wells



Example site showing deteriorating trends.

What are the main attributes of the Grand Forks Aquifer?

The Grand Forks Aquifer, located in the Kettle River Valley at Grand Forks, is comprised of sand and gravel and is highly productive, but also highly vulnerable to contamination. It is the main source of water supply to the community for drinking, irrigation and livestock.

What are the main human influences on water quality?

The main source of contamination to ground waters is leaching of substances from the land surface. These substances include nitrate from local agriculture, horticulture and septic systems, and hydrocarbon contaminants from local industrial sites.

What water quality indicators were monitored?

Nutrients, major ions, trace elements, dissolved solids, and temperature have been monitored annually since 1991. Trace hydrocarbons were not monitored.

What are the water quality trends in the Grand Forks Aquifer?

There are sixteen sampling wells at eight sites with enough long-term data (more than five years) to assess water quality trends. For nitrate, four wells show deteriorating trends, nine wells show no changes, and three wells show improving trends.

The graph shows that nitrate levels decreased with depth in the aquifer at Site A, indicating that the nitrate was from surface sources. Nitrate levels at the 12-m depth have increased over time (a deteriorating trend), remaining above the drinking water guideline. Nitrate levels at the 30-m depth were below the drinking water guideline, but have increased over the last two years and now exceed the guideline. The trends are likely due to an increase in nitrate loading due to fertilizer and irrigation practices at nearby farms, nurseries, and residences. The majority of the drinking water comes from the deeper wells.

It is important to note that each well provides information on water quality at a specific point in the aquifer. Results at each well are affected by land use and natural factors at and directly up-gradient from that well only, and are not representative of the entire aquifer.

continued on next page

What is the environmental significance of the trends?

The nitrate levels in local portions of the aquifer were elevated with four of 16 wells exceeding the drinking water guideline. Consequently, the water quality was rated as fair in the 1996 B.C. Water Quality Status Report. Bottle-fed infants less than six months of age could be at risk of developing methaemoglobinaemia if the well water was used in the preparation of their infant formula. The nitrate/nitrite combines with the haemoglobin in the infant's blood and hinders the transfer of oxygen, preventing oxygen from getting to the body.

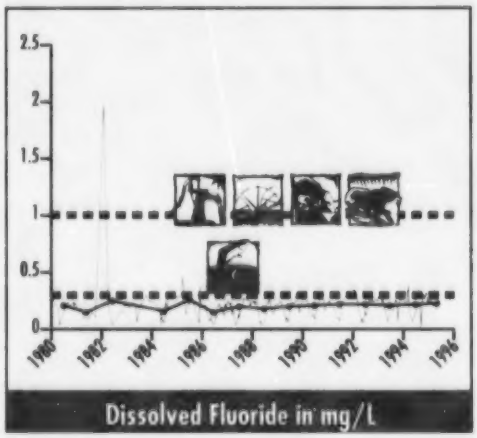
What will be done to improve water quality?

An aquifer protection committee has been formed in Grand Forks to lead community actions to protect water quality, and the Ministry will provide technical advice to develop well and aquifer protection plans. The main remedy will be reduction in nitrate loading to the aquifer by adopting best management practices. Local residents can help by minimizing their use of fertilizers and pesticides, and properly disposing of their household hazardous wastes. The Regional District of Kootenay-Boundary will aim to limit lot densities in their upcoming revision of the Official Community Plan to minimize nitrate loading from the septic systems to the aquifer. The Ministry will continue to monitor the groundwater quality and water levels at selected sites in the aquifer in partnership with the local Health Services Society and the aquifer protection committee.

Kettle River at Gilpin

What are the water quality trends?
There were no environmentally significant changes.

No changes



Dissolved Fluoride in mg/L

What are the main attributes of the Kettle River?

The Kettle River drains 5,750 km^2 of the Monashee Mountains and the Okanagan Highland in B.C. south into Washington State at Midway. It then drains an additional 980 km^2 of the Monashee Mountains in northern Washington State before looping back into B.C. at Carson with a drainage area of 6,730 km^2. From Carson, the Kettle makes a small loop northward, draining the Granby River and Christina Lake before entering Washington State again near Laurier with a drainage area of 9,840 km^2. The river is used for drinking and irrigation water supply, and supports several species of trout.

What are the main human influences on water quality?

The main potential influences on water quality are forest harvesting, agriculture, treated sewage from the City of Grand Forks, and a proposed mine in Washington State.

What water quality indicators were monitored?

Major ions, trace elements, nutrients, colour, cyanide, dissolved and suspended solids, pH and temperature were monitored once every two weeks from 1980 to 1995 on the Kettle River at Gilpin, which has a drainage area of about 8,960 km^2. Flow has been measured continuously downstream near Laurier (9,840 km^2).

What are the water quality trends and what caused them?

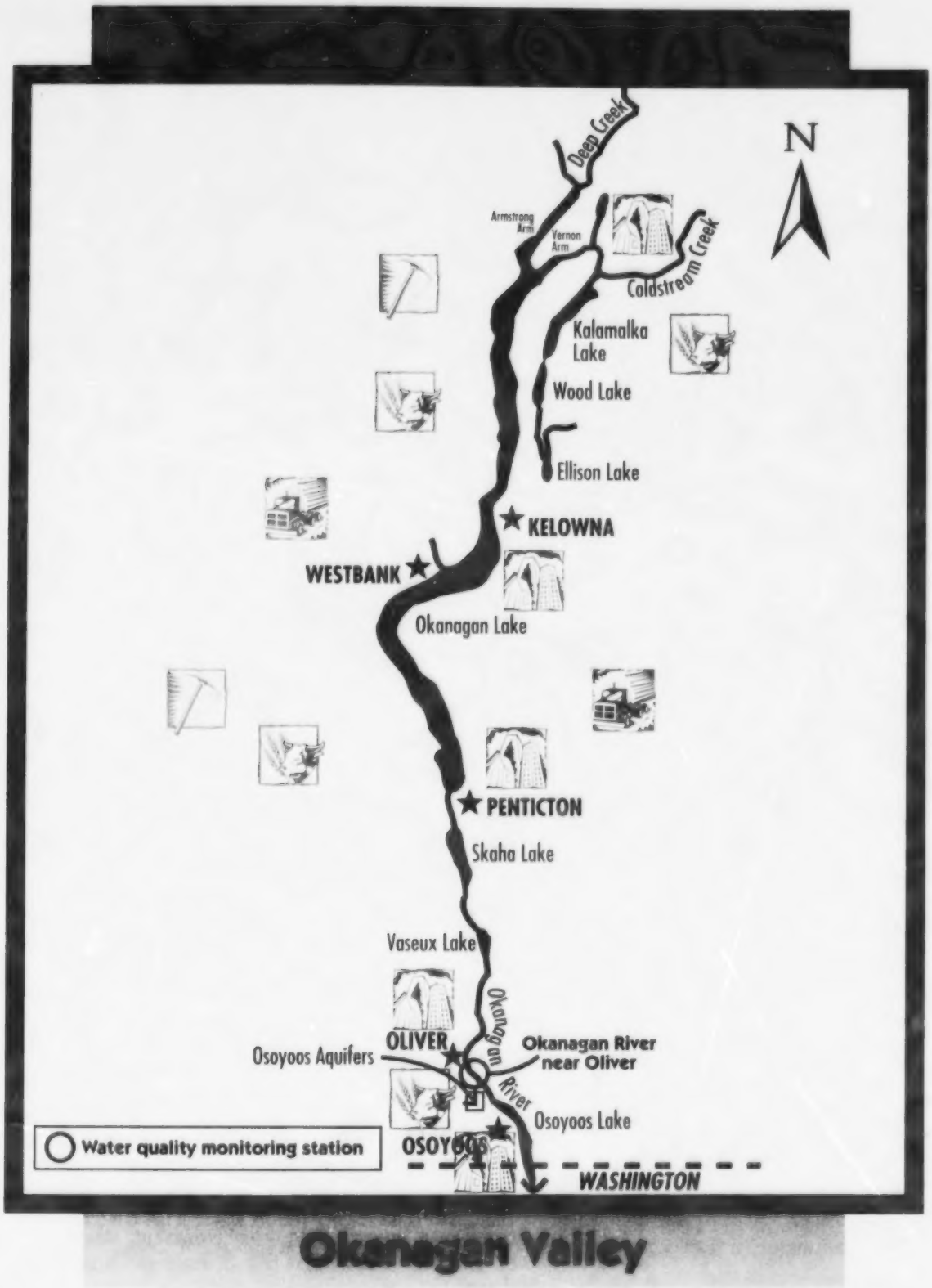
There were no environmentally significant changes from 1980 to 1995.

Are there any other water quality concerns?

Fluoride levels in the Kettle River at Gilpin at times exceeded the guideline to protect aquatic life. However, the levels are naturally occurring and similar to those measured upstream at Midway and Carson. We are not aware of any effects on fish populations. The water quality of the Kettle River was not evaluated in the 1996 B.C. Water Quality Status Report.

Does anything need to be done?

There are no human-caused water quality changes or concerns that require action at this time, and monitoring was suspended in 1995. However, monitoring is continuing upstream at Midway and Carson.



Okanagan Valley

Okanagan River at Oliver

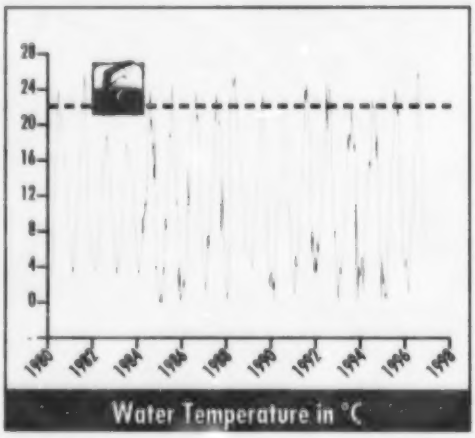
What are the water quality trends?
There were no environmentally significant changes.

No changes

What are the main attributes of the Okanagan River?
The Okanagan River drains about 8,000 km^2 into Washington State near Osoyoos. The Okanagan River and its chain of lakes is used for drinking water, irrigation, livestock watering, and recreation such as swimming, and supports significant aquatic life and wildlife populations.

What are the main human influences on water quality?
These include agriculture, municipal waste water and storm water discharges, septic tanks and tile fields, and forestry.

What water quality indicators were monitored?
Major ions, trace elements, nutrients, colour, dissolved and suspended solids, pH and temperature have been monitored once every two weeks since 1980 at a station midway between Oliver and Osoyoos Lake (No. 18 Road). Flow has been monitored continuously at this location, which has a drainage area of 7,590 km^2.

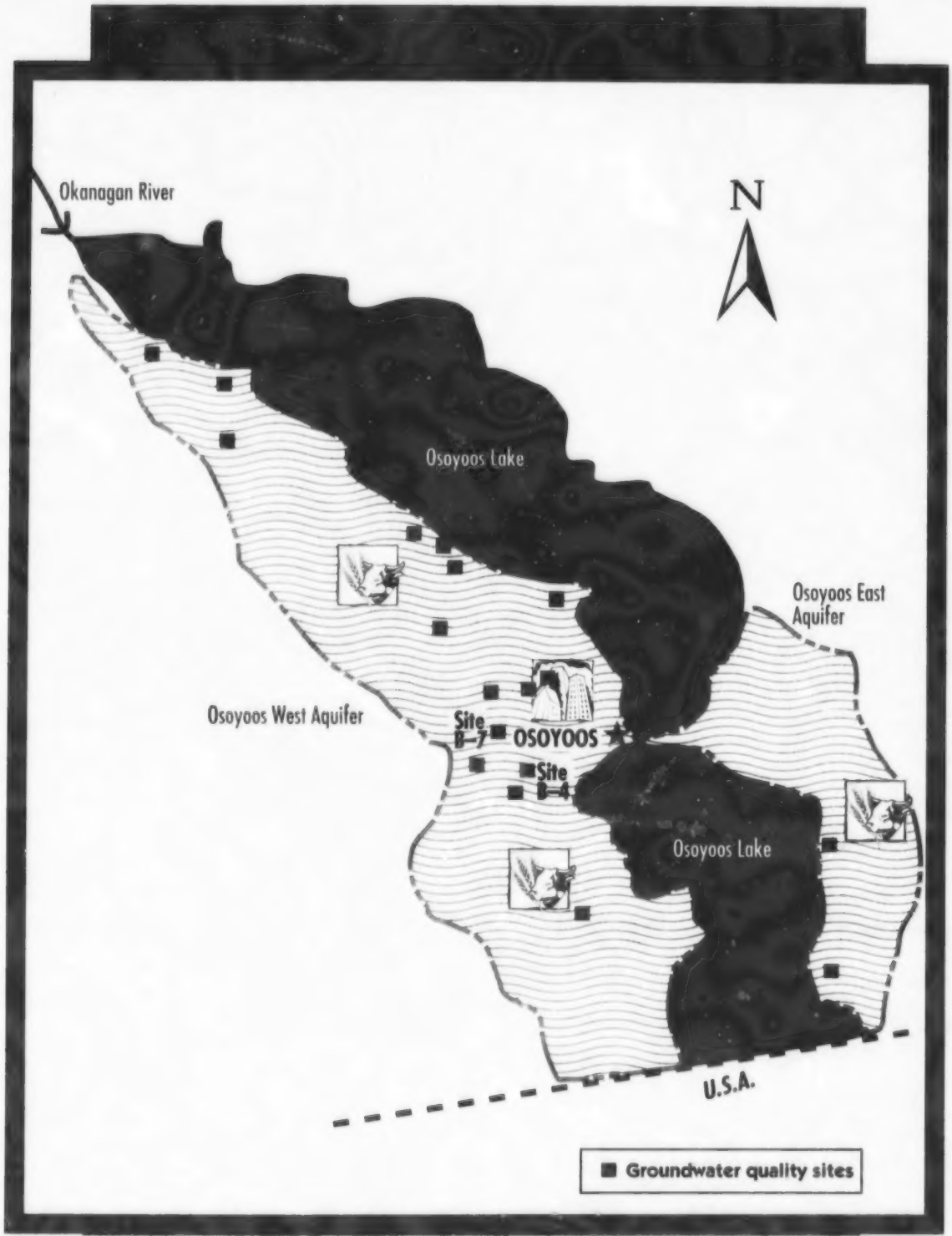


Water Temperature in °C

What are the water quality trends and what caused them?
There were no environmentally significant changes from 1979 to 1995.

Are there any other water quality concerns?
Summer water temperatures in the river exceeded the safe upper limit for coldwater fish, such as salmonids, during most summers. This may limit the use of the river by coldwater fish during the summer. Summer water temperatures are naturally high in this semi-arid, warm region, but human activities such as flow regulation, channelization, and removal of streambank shade trees have probably increased peak water temperatures. The water quality of the Okanagan River was not evaluated in the 1996 B.C. Water Quality Status Report.

What will be done?
Monitoring will continue on the Okanagan River at Oliver, including air and water temperature, to track any changes in the quality of the water flowing into Osoyoos Lake and Washington State.



Osoyoos Aquifers

Osoyoos Aquifers

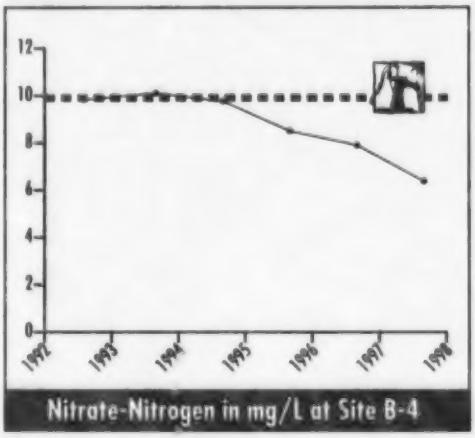
What are the water quality trends?

The nitrate levels at 78% of the wells in the Osoyoos Aquifers showed improving trends or no changes, but 22% showed deteriorating trends. The drinking water guideline for nitrate was exceeded in 9 of 23 wells.

Improving Trends - 8 wells

No Changes - 10 wells

Deteriorating Trends - 5 wells



Example site showing an improving trend.

What are the main attributes of the Osoyoos Aquifers?

Two shallow sand and gravel aquifers occupy the areas east and west from Osoyoos Lake. These aquifers are important sources of drinking and irrigation water supply and are highly vulnerable to contamination.

What are the main human influences on water quality?

These include nitrate from agriculture (chemical fertilizers) and septic systems. Other potential groundwater contamination sources are a sanitary landfill, and a wastewater disposal pond used for irrigating a golf course. The aquifers also discharge into Osoyoos Lake and may therefore affect the water quality of the lake.

What water quality indicators are monitored?

Nutrients, major ions, trace elements, dissolved solids and temperature were monitored since 1987.

What are the water quality trends in the Osoyoos Aquifers and what caused them?

There are twenty-three active groundwater monitoring wells at eighteen sites with sufficient long-term water quality data to assess water quality trends. The majority of the water quality monitoring wells are located within the aquifer west of Osoyoos Lake. For nitrate-nitrogen, eight wells show improving trends, five wells show deteriorating trends, and ten wells show no changes. Data collected between 1988 and 1991 were from bailed samples and not pumped, and therefore are suspect and have been omitted. The eight wells showing an improving trend suggest that some orchardists and residents are adopting improved management practices for chemical fertilizer use. The graphs show that nitrate levels have decreased (improved) over time at Site B-4, but increased at Site B-7.

It is important to note that each well provides information on water quality at a specific point in the aquifer. Results at each well are affected by land use and natural factors at or near and directly up-gradient from the well, and are not representative of the entire aquifer.

What is the environmental significance of the trends?

The nitrate levels in local portions of the aquifer were elevated with nine of 23 wells exceeding the drinking water guideline. Bottle-fed infants less

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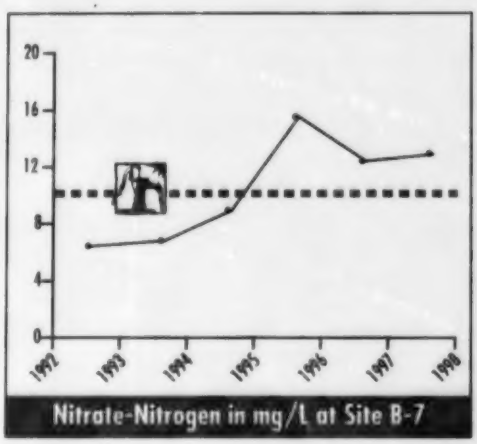
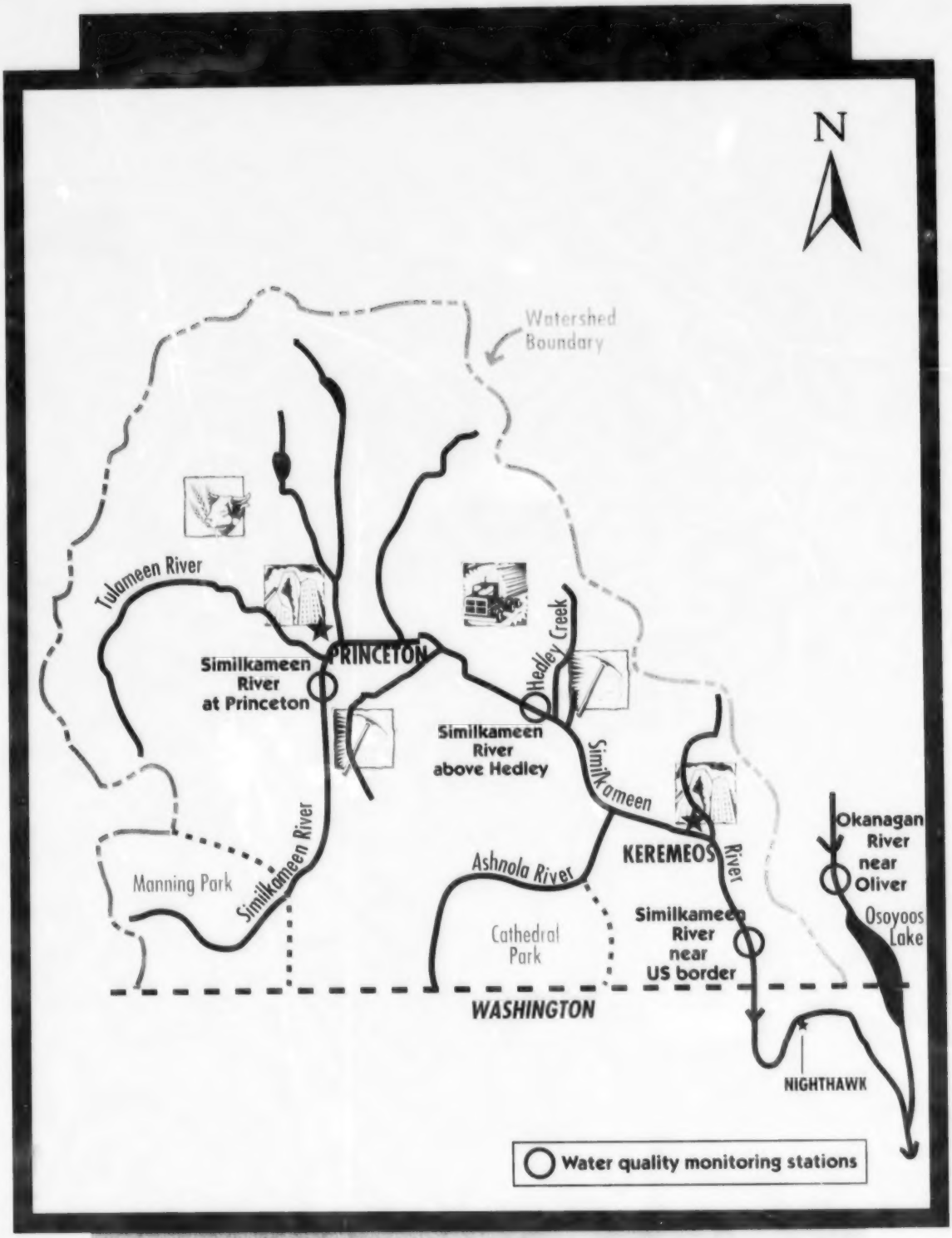


Example site showing a deteriorating trend.

than six months of age could be at risk of developing methaemoglobinaemia if the well water was used in the preparation of their infant formula. The nitrate/nitrite combines with the haemoglobin in the infant's blood and hinders the transfer of oxygen, preventing oxygen from getting to the body. The water quality of the Osoyoos Aquifers was not evaluated in the 1996 B.C. Water Quality Status Report.

What will be done to improve water quality?

The main remedy will be reduction in nitrate loading to these aquifers by adopting best management practices. Residents can help by minimizing their use of fertilizers and pesticides. The Ministry will continue to monitor the groundwater quality of these aquifers, and continue to encourage groups in the local community to develop well and aquifer protection plans to protect water quality. Ministry staff have trained members of the Osoyoos Lake Water Quality Society in water sampling procedures for domestic wells.

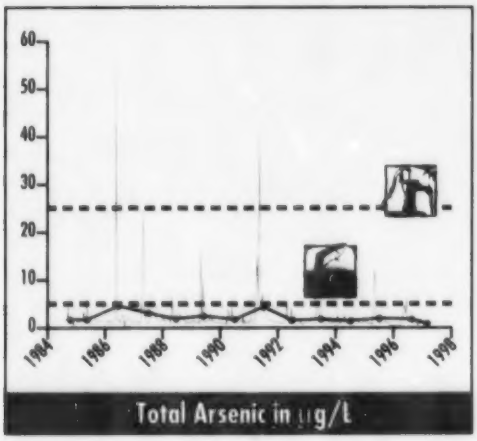


Similkameen River Basin

What are the water quality trends?

There was an improving trend in arsenic, but the specific causes are not known.

Improving trend



Total Arsenic in µg/L

What are the main attributes of the Similkameen River?

The Similkameen River drains about 9,200 km^2 of the Cascade Mountains and the Interior Plateau in B.C. to the Okanagan River in Washington State just downstream from Osoyoos Lake. The river is used for drinking, irrigation, livestock, industrial water supply, and recreation, and supports healthy populations of salmonids and a variety of other fish species.

What are the main human influences on water quality?

These include agriculture (fruit farming and cattle ranching), metal mining near Princeton and Hedley, forestry, and treated municipal waste water from Princeton and Keremeos.

What water quality indicators were monitored?

Water quality has been monitored at three stations on the Similkameen River: Princeton, above Hedley, and about 10 km upstream from the US border as shown on the map opposite. Major ions, trace elements, nutrients, colour, cyanide, dissolved and suspended solids, pH and temperature have been monitored once every two weeks since 1984 at the US border station and since 1989 at Princeton and above Hedley. The US border station also had less frequent monitoring for the same characteristics during 1979–83, and sporadic fecal coliform monitoring during 1982–93. Flow has been monitored continuously at Princeton (1,850 km^2), near Hedley (5,590 km^2), and near Nighthawk, Washington (9,190 km^2).

What are the water quality trends and what caused them?

There was a declining trend in total arsenic at the station near the US border, but the specific causes of this improvement are not known. (Arsenic levels at Princeton and above Hedley were low and showed no changes.) The peaks in total arsenic were related to the peaks in turbidity during spring freshets, and thus the arsenic was probably due to the erosion of arsenic-bearing minerals. Active and abandoned mines downstream from Hedley may have been the source of the arsenic due to the erosion of tailings and waste rock.

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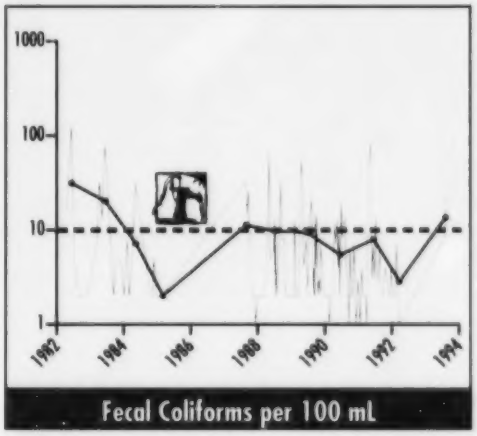


Fecal Coliforms per 100 mL

What is the environmental significance of the trend?

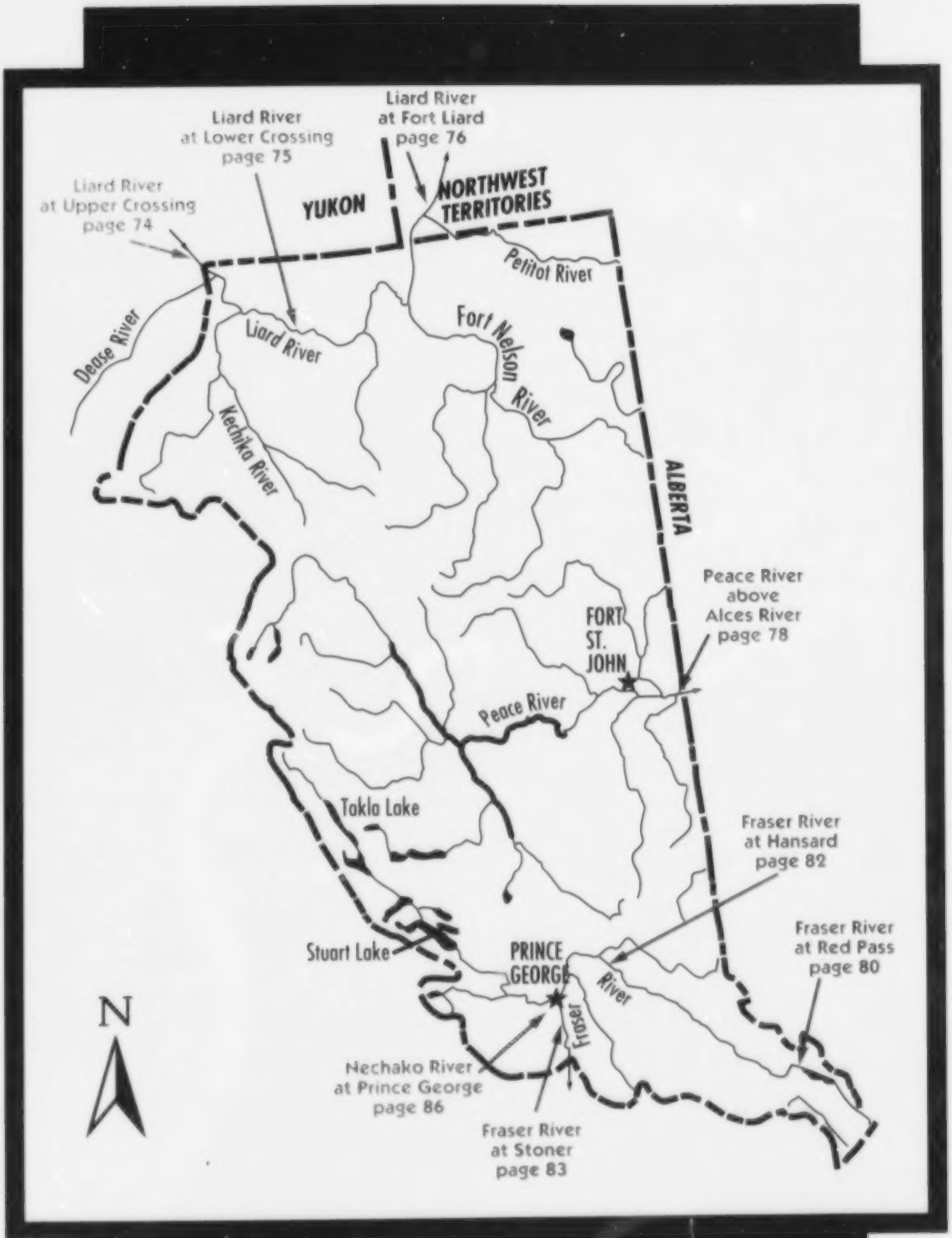
Arsenic levels occasionally exceeded the water quality guidelines for drinking water and aquatic life during spring freshets over the last decade. However, with the declining trend, the frequency and amount by which the guidelines were exceeded decreased substantially. In the last five years, the drinking water guideline was not exceeded and the aquatic life guideline was exceeded only a few times by a small amount. In addition, because the peak arsenic was related to peak turbidity, the arsenic was probably in a particulate form, which would not have been available to aquatic life and would have been removed by the treatment needed to remove turbidity prior to drinking.

Are there any other water quality concerns?

The fecal coliform objective to protect raw drinking water that will receive only disinfection prior to drinking was regularly not met, probably due to cattle. This was noted in the 1996 B.C. Water Quality Status Report which rated the water quality as good. However, the turbidity levels in the river were such that partial treatment (e.g., settling, filtration) and disinfection were needed much of the time, suggesting that the fecal coliform objective may be too stringent. If revising the objective is not acceptable, then remedial measures to reduce non-point sources of fecal contamination, especially from cattle, will be needed.

What will be done?

Monitoring will continue on the Similkameen River at Princeton and near the US border, including fecal coliforms, turbidity, and arsenic to determine whether remedial measures are needed.



Omineca – Peace Region

OMINECA-PEACE REGION SUMMARY

The Omineca-Peace Region is located in the northeastern part of the Province, bordering northern Alberta, the Yukon and the Northwest Territories. It extends from Alberta in the east to Takla and Stuart lakes in the west, as shown on the map opposite. The Liard River, the Peace River, and the Fraser River are the major watersheds in the Region. The main BC Environment regional office is located in Prince George.

There were eight long-term water quality monitoring stations in this Region: three on the Liard River, one on the Peace River, three on the Fraser River, and one on the Nechako River, a major tributary of the Fraser River. Seven stations had no changes, while the Fraser River at Stoner had improving trends in water quality.

If you have any questions on the trend report or want more information on other waterbodies in the Region, please contact:

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Deteriorating Trends in Water Quality

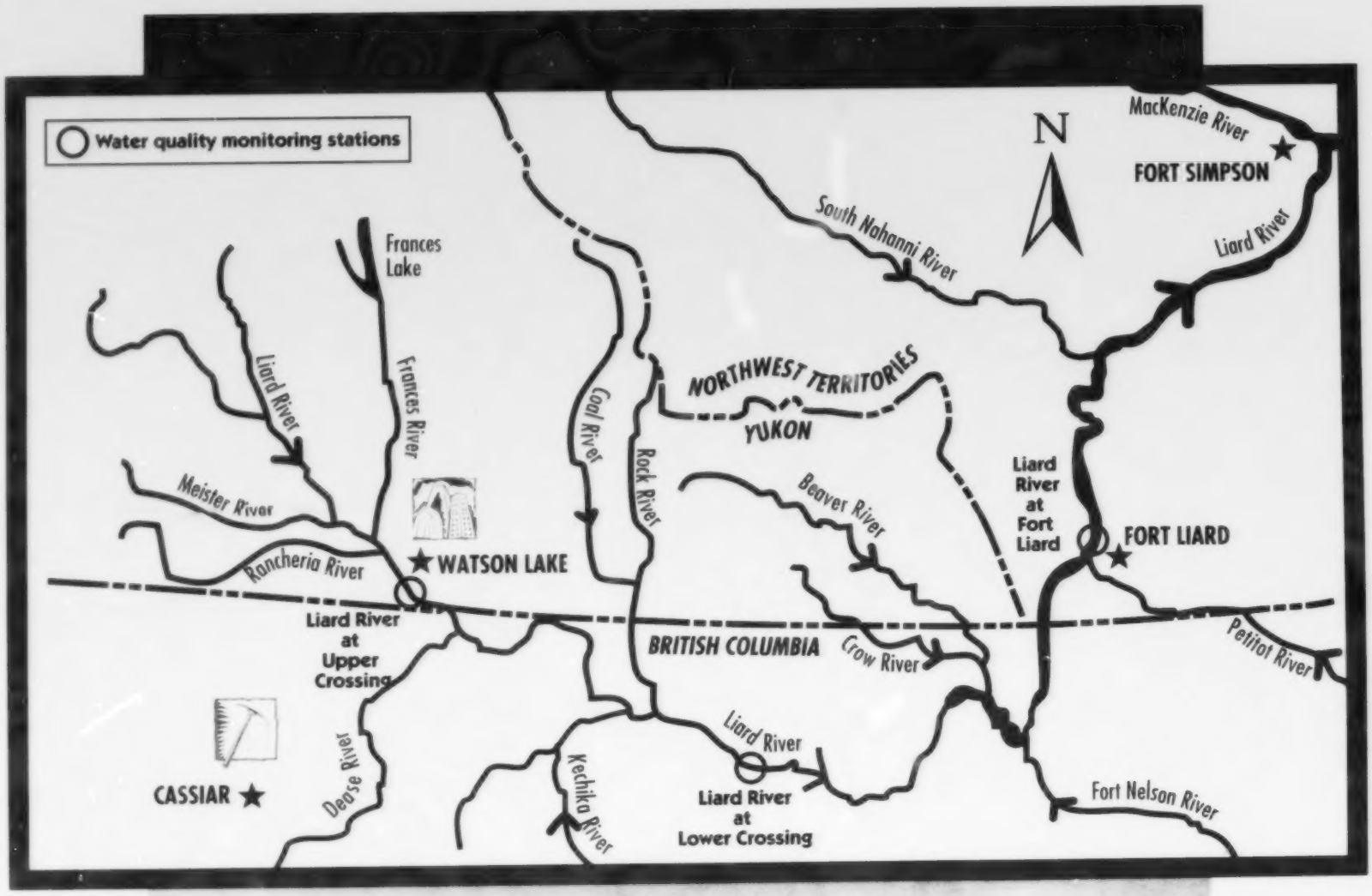
Location (Years)	Water Quality Indicators	Cause of Trend	Water Uses at Risk	Action
None				

Improving Trends in Water Quality

Location (Years)	Water Quality Indicators	Cause of Trend	Water Uses at Risk	Action
Fraser River at Stoner (1990–97)	AOX	Pulp mill waste abatement	Aquatic life, and their wildlife and human consumers	Monitoring is continuing.

No Changes in Water Quality – Other Water Quality Concerns

Location (Years)	Water Quality Indicators	Concern	Water Uses at Risk	Action
Liard River at Upper Crossing (1983–94)		None		Monitoring is continuing.
Liard River at Lower Crossing (1984–94)		None		Monitoring is continuing at Upper Crossing and Fort Liard.
Liard River at Fort Liard (1984–95)		None		Monitoring is continuing.
Peace River above Alces River (1984–94)	Turbidity, suspended solids, metals	High levels during spring freshet	Aquatic life, drinking water, recreation	Monitoring is continuing to assess the effects.
Fraser River at Red Pass (1985–94)		None		Monitoring is continuing.
Fraser River at Hansard (1985–94)		None		Monitoring is continuing.
Nechako River at Prince George (1985–95)		None		Monitoring is continuing.



Liard River Area

Liard River at Upper Crossing

What are the water quality trends?
There were no environmentally significant changes.

No changes

What are the main attributes of the Liard River at Upper Crossing?

The Liard River at Upper Crossing drains 33,400 km^2 of the Yukon Territory into northern B.C. near Watson Lake, Yukon. The Liard River supports at least 21 species of fish with arctic grayling being the most abundant sports fish. Fishing pressure for subsistence and recreation is light. There is little or no other use of the water in this lightly populated and undeveloped watershed.

What are the main human influences on water quality?

The main potential influences on water quality are mining exploration in the headwaters of the Liard basin and forestry around the Meister, Rancheria, and Liard rivers, but the basin is lightly developed at present with relatively pristine water quality.

What water quality indicators were monitored?

Major ions, trace elements, nutrients, colour, dissolved and suspended solids, pH, and temperature were monitored about once every two weeks since 1983 just downstream from the upper crossing of the Alaska Highway over the Liard River. Flow has been monitored continuously at the same location.

What are the water quality trends and what caused them?

There were no environmentally significant trends from 1983 through 1994.

Are there other water quality concerns?

No. The water quality of the Liard River was not evaluated in the 1996 B.C. Water Quality Status Report.

What will be done to maintain water quality?

There were no environmentally significant changes or other water quality concerns at this time. There is potential for significant mining development in the Liard River headwaters in the Yukon, and Environment Canada is continuing to monitor this station.

Liard River at Lower Crossing

What are the water quality trends?
There were no environmentally significant changes.

No changes

What are the main attributes of the Liard River at Lower Crossing?

The Liard River at Lower Crossing drains 104,000 km^2 of the Yukon Territory and northern B.C. The Liard River supports at least 21 species of fish with arctic grayling being the most abundant sports fish. Fishing pressure for subsistence and recreation is light. There is little or no other use of the water in this lightly populated and undeveloped watershed.

What are the main human influences on water quality?

The main potential influences on water quality are mining exploration in the headwaters of the Liard basin and forestry in both the Yukon and B.C. portions of the basin, but the basin is lightly developed at present with relatively pristine water quality.

What water quality indicators were monitored?

Major ions, trace elements, nutrients, colour, dissolved and suspended solids, pH, and temperature were monitored about once every one or two months from 1984 to 1995 at the lower crossing of the Alaska Highway over the Liard River. Flow has been monitored continuously at this location.

What are the water quality trends and what caused them?

There were no environmentally significant changes from 1984 through 1994.

Are there other water quality concerns?

No. The water quality of the Liard River was not evaluated in the 1996 B.C. Water Quality Status Report.

What will be done to maintain water quality?

There were no environmentally significant changes or other water quality concerns at this time, and monitoring was suspended in 1995. Environment Canada is continuing to monitor the Liard River at Upper Crossing and at Fort Liard.

Liard River at Fort Liard

What are the water quality trends?
There were no environmentally significant changes.

No changes

What are the main attributes of the Liard River at Fort Liard?

The Liard River at Fort Liard drains 222,000 km^2 of the Yukon Territory and northern B.C. into the Northwest Territories (NWT). The Liard River supports at least 21 species of fish with arctic grayling being the most abundant sports fish. Fishing pressure for subsistence and recreation is light. There is little or no other use of the water in this lightly populated and undeveloped watershed.

What are the main human influences on water quality?

The main potential influences on water quality are mining exploration in the headwaters of the Liard basin, forestry in both the Yukon and B.C. portions of the basin, and oil and gas development in the Fort Nelson River basin in B.C. The basin is lightly developed at present with relatively pristine water quality.

What water quality indicators were monitored?

Major ions, trace elements, nutrients, colour, dissolved and suspended solids, pH, and temperature were monitored about once every one or two months since 1984 in the NWT about 35 km downstream from the B.C. border. Flow has been monitored continuously at this location, which is just downstream from the Petitot River.

What are the water quality trends and what caused them?

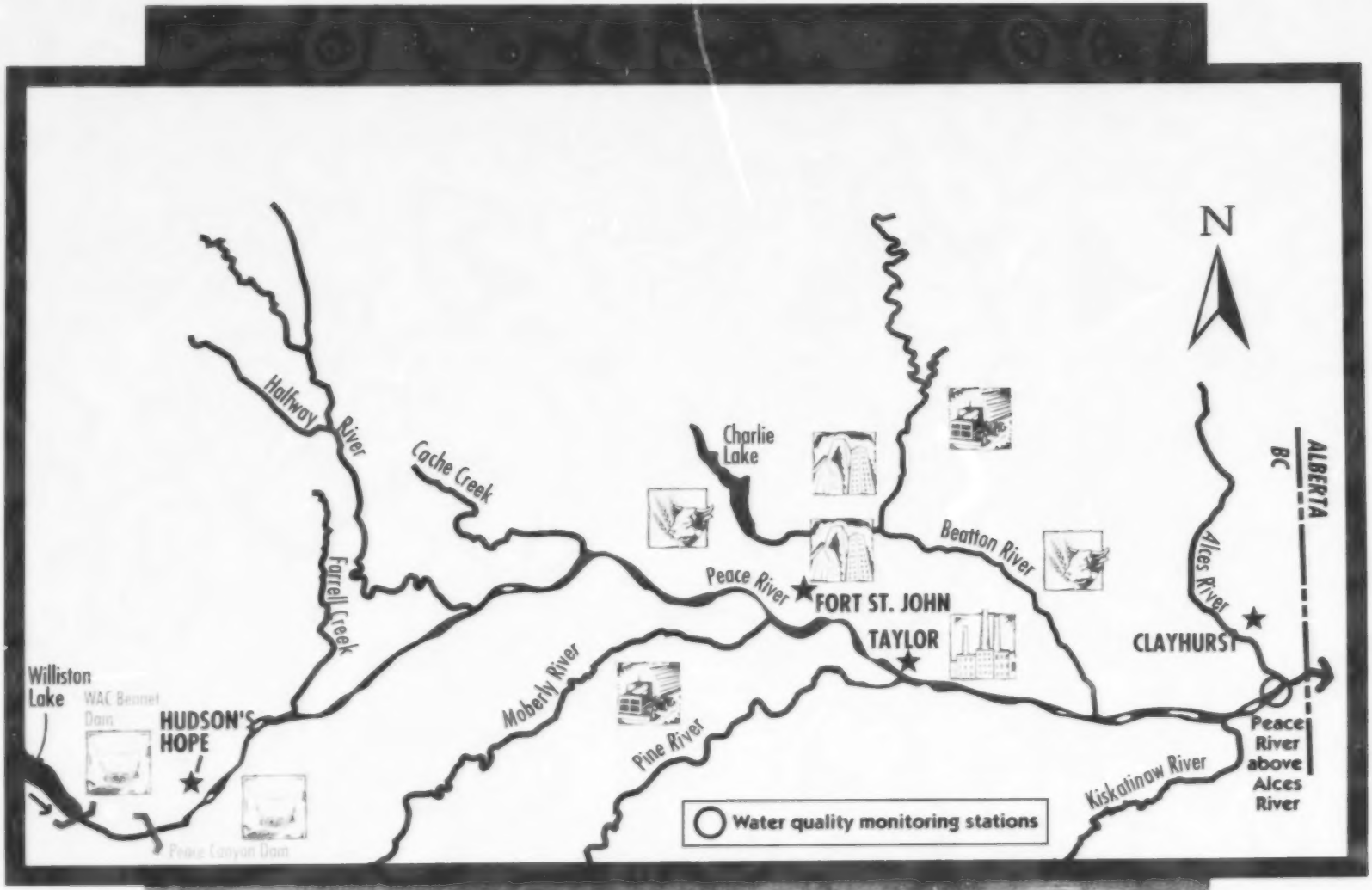
There were no environmentally significant changes from 1984 through 1995.

Are there other water quality concerns?

No. The water quality of the Liard River was not evaluated in the 1996 B.C. Water Quality Status Report.

What will be done to maintain water quality?

There were no environmentally significant changes or other water quality concerns at this time. Environment Canada is continuing to monitor at this station, given the potential for future development in the basin.

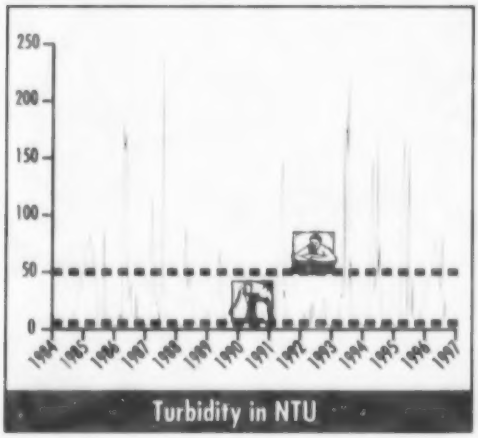


Peace River Area

Peace River above Alces River

What are the water quality trends?
There were no environmentally significant changes.

No changes



Turbidity in NTU

What are the main attributes of the Peace River above Alces River?

The Peace River above Alces River drains 118,000 km^2 of northern B.C. into Alberta. The water sampling station is located 4 km upstream from the Alberta border. About three-quarters of the flow at the border comes from the Williston Reservoir behind the W.A.C. Bennett Dam, while one-quarter comes from the many tributaries to the Peace downstream from the dam. The river is used for raw drinking water for Taylor and Hudson's Hope, sports fishing, recreation, and irrigation. The Peace River was declared a B.C Heritage River in 1998 because of its historical, cultural, recreational, and wildlife values.

What are the main human influences on water quality?

The main potential influences on water quality are the W.A.C. Bennett Dam and it's massive reservoir, Williston Lake, the Peace Canyon Dam, the McMahon gas processing plant and Fibreco pulp mill at Taylor, treated sewage from the City of Fort St. John, oil and gas production, agriculture and forestry.

What water quality indicators were monitored?

Major ions, trace elements, nutrients, colour, dissolved and suspended solids, pH, cyanide, fecal coliforms, and temperature were monitored once every two weeks since 1984. Flow has been monitored continuously near Taylor, 28 km upstream.

What are the water quality trends and what caused them?

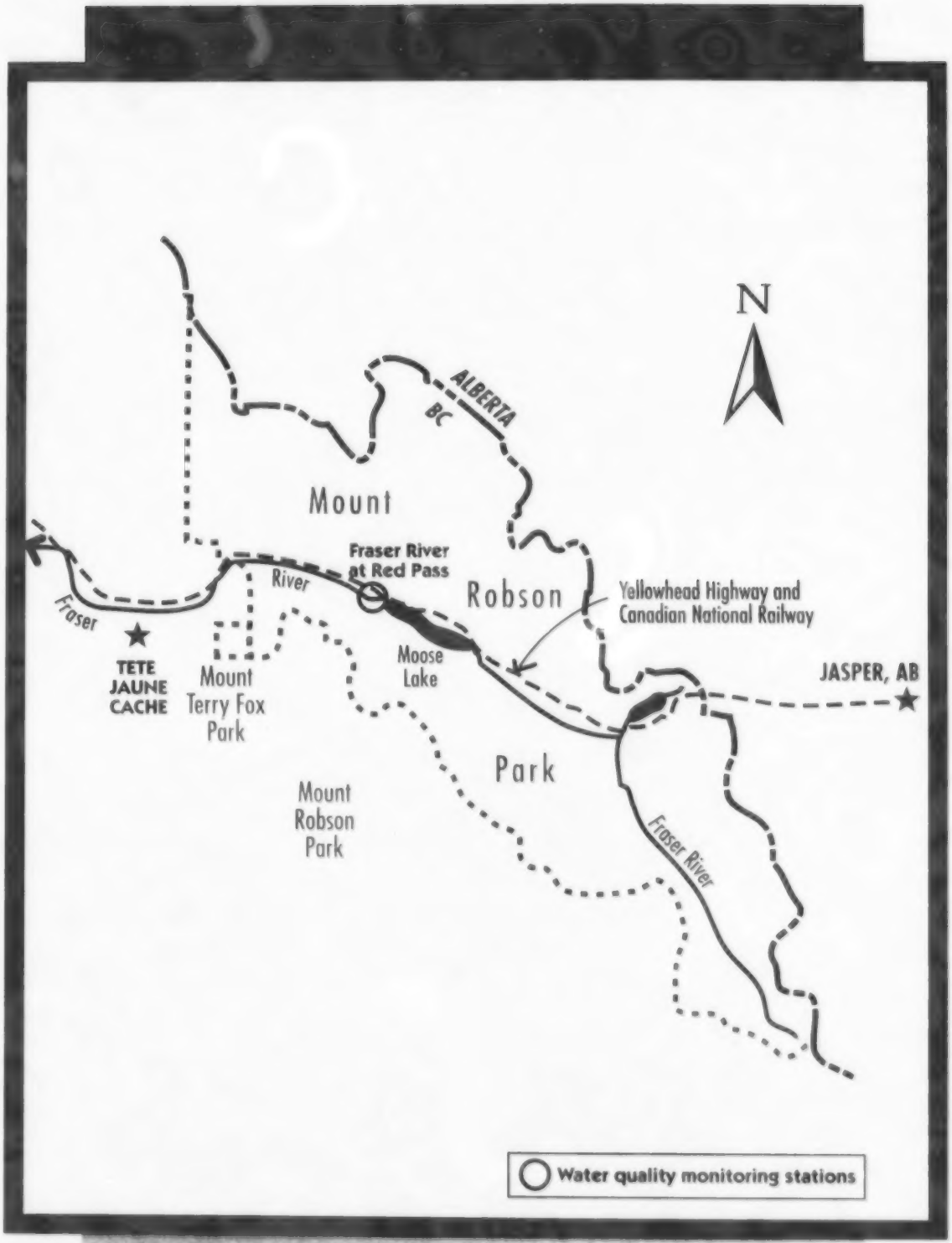
There were no environmentally significant changes from 1984 through 1994.

Are there any water quality concerns?

The 1996 B.C. Water Quality Status Report rated the water quality of the Peace River as fair, because objectives for fecal coliforms, suspended solids, turbidity, the growth of algae, and metals were sometimes not met. Similarly, we found that suspended solids and turbidity levels (see plot) were high in the Peace River above Alces River during snowmelt and heavy rains, causing the guidelines for several metals to be exceeded at times. However, because the metals were associated with suspended solids, they probably were not available to harm aquatic life.

What will be done to maintain water quality?

Monitoring of the Peace River above Alces River is continuing, including measures to assess the biological availability of the metals.



Fraser River Headwaters

Fraser River at Red Pass

What are the water quality trends?
There were no environmentally significant changes.

No changes

What are the main attributes of the Fraser River at Red Pass?

The Fraser River at Red Pass drains 1,700 km^2 of the Rocky Mountains entirely within Mount Robson Provincial Park at the headwaters of the Fraser River. This is a relatively pristine watershed with high recreational values.

What are the main human influences on water quality?

The main potential influences on water quality are the Yellowhead Highway and the Canadian National Railway, which run alongside the Fraser River and Moose Lake through Mount Robson Park, recreational activities in the park, and atmospheric deposition of contaminants carried by rain and snow.

What water quality indicators were monitored?

Major ions, trace elements, nutrients, colour, dissolved and suspended solids, pH, and temperature were monitored once every two weeks since 1985 just downstream from Moose Lake. Flow has been monitored continuously.

What are the water quality trends and what caused them?

There were no environmentally significant changes from 1985 through 1994.

Are there other water quality concerns?

No. The water quality of the Fraser River above Hope was not evaluated in the 1996 B.C. Water Quality Status Report. Additional information on environmental quality in the upper Fraser River watershed is available in the Environment Canada report, Health of the Fraser River Aquatic Ecosystem – A Synthesis of Research Conducted under the Fraser River Action Plan.

What will be done to maintain water quality?

Monitoring is continuing at Red Pass, which will serve as a relatively pristine control station for the Fraser basin and the province to detect trends due to atmospheric changes, for quality assurance of the monitoring network, and to measure downstream brest harvesting effects.

Upper Fraser River Basin

Fraser River at Hansard

What are the water quality trends?
There were no environmentally significant changes.

No changes

What are the main attributes of the Fraser River at Hansard?

The Fraser River at Hansard is located in the Rocky Mountain Trench between the Columbia and Rocky Mountains, draining 18,000 km^2 of the headwaters of the Fraser River that lies in these mountain ranges. The water in this reach is used for drinking, irrigation, recreation and industry, and sustains significant fish and wildlife resources. The Fraser River from Tete Jaune Cache to Greater Vancouver has been designated as a B.C. and a Canadian Heritage River.

What are the main human influences on water quality?

The main potential influences on water quality are forestry, agriculture, treated sewage from McBride, and the Yellowhead Highway and the Canadian National Railway, which run alongside the river most of the way from the headwaters to Hansard.

What water quality indicators were monitored?

Major ions, trace elements, nutrients, colour, dissolved and suspended solids, pH, adsorbable organo-halides, fecal coliforms, and temperature were monitored once every two weeks since 1985. Flow has been monitored continuously.

What are the water quality trends and what caused them?

There were no environmentally significant changes from 1985 through 1994.

Are there other water quality concerns?

Not at this time. The water quality of the Fraser River above Hope was not evaluated in the 1996 B.C. Water Quality Status Report. Additional information on environmental quality in the upper Fraser River watershed is available in the Environment Canada report, Health of the Fraser River Aquatic Ecosystem – A Synthesis of Research Conducted under the Fraser River Action Plan.

What will be done to maintain water quality?

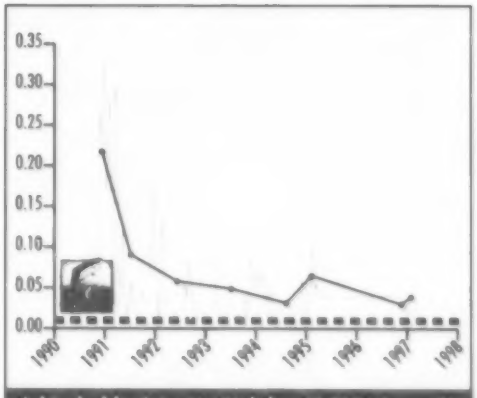
Monitoring is continuing at Hansard, which will serve as a control station for the Fraser basin upstream from the industrial and municipal waste discharges at Prince George and further downstream.

Fraser River at Stoner

What are the water quality trends?

The Fraser River at Stoner had an improving trend in adsorbable organo-halides (AOX), a measure of chlorinated organics, due to waste abatement at the pulp mills at Prince George. The objective for AOX was still not attained consistently, but this was not deemed serious because the objectives for specific chlorinated organics were attained.

Improving trend



Adsorbable Organic Halides (AOX) in mg/L

What are the main attributes of the Fraser River at Stoner?

The Fraser River at Stoner is located about 30 km downstream from Prince George and the confluence with the Nechako River, and drains about 75,000 km^2 of the upper Fraser River basin. It is the first accessible point downstream from Prince George where the Fraser and Nechako rivers are well mixed. The water in this reach is used for drinking water, irrigation, livestock watering, recreation and industry, and sustains significant fish and wildlife resources, including the massive Fraser River salmon runs. The Fraser River has been designated as a B.C. Heritage River and a Canadian Heritage River.

What are the main human influences on water quality?

The main influences on water quality are the effluents from three pulp mills at Prince George, treated sewage from Prince George, and non-point source runoff from forestry, agriculture, and urban areas.

What water quality indicators were monitored?

Adsorbable organo-halides (AOX) were monitored once every two weeks since late 1990. AOX was also monitored at the Fraser River at Marguerite (see Cariboo Region) and Hope (see Lower Mainland Region).

What are the water quality trends and what caused them?

The Fraser River at Stoner had an improving trend in adsorbable organo-halides (AOX), a general measure of chlorinated organics, due to waste abatement at the pulp mills at Prince George. The objective for AOX was still not consistently attained, but this was deemed not to be serious because the objectives for specific toxic chlorinated organics were attained.

What is the environmental significance of the trends?

The decline in AOX indicates that chlorinated organics, which can be toxic to aquatic life and to humans and wildlife that consume aquatic life, have been reduced substantially in the Fraser River. For example, chlorinated phenols in the Fraser River at Stoner were no longer

continued on next page

detectable and met the objectives in 1995. Similarly, dioxins and furans in mountain whitefish muscle declined between 1990-91 and 1995, and met the objective in 1995. The Ministry of Health lifted restrictions on the consumption of fish muscle in 1994.

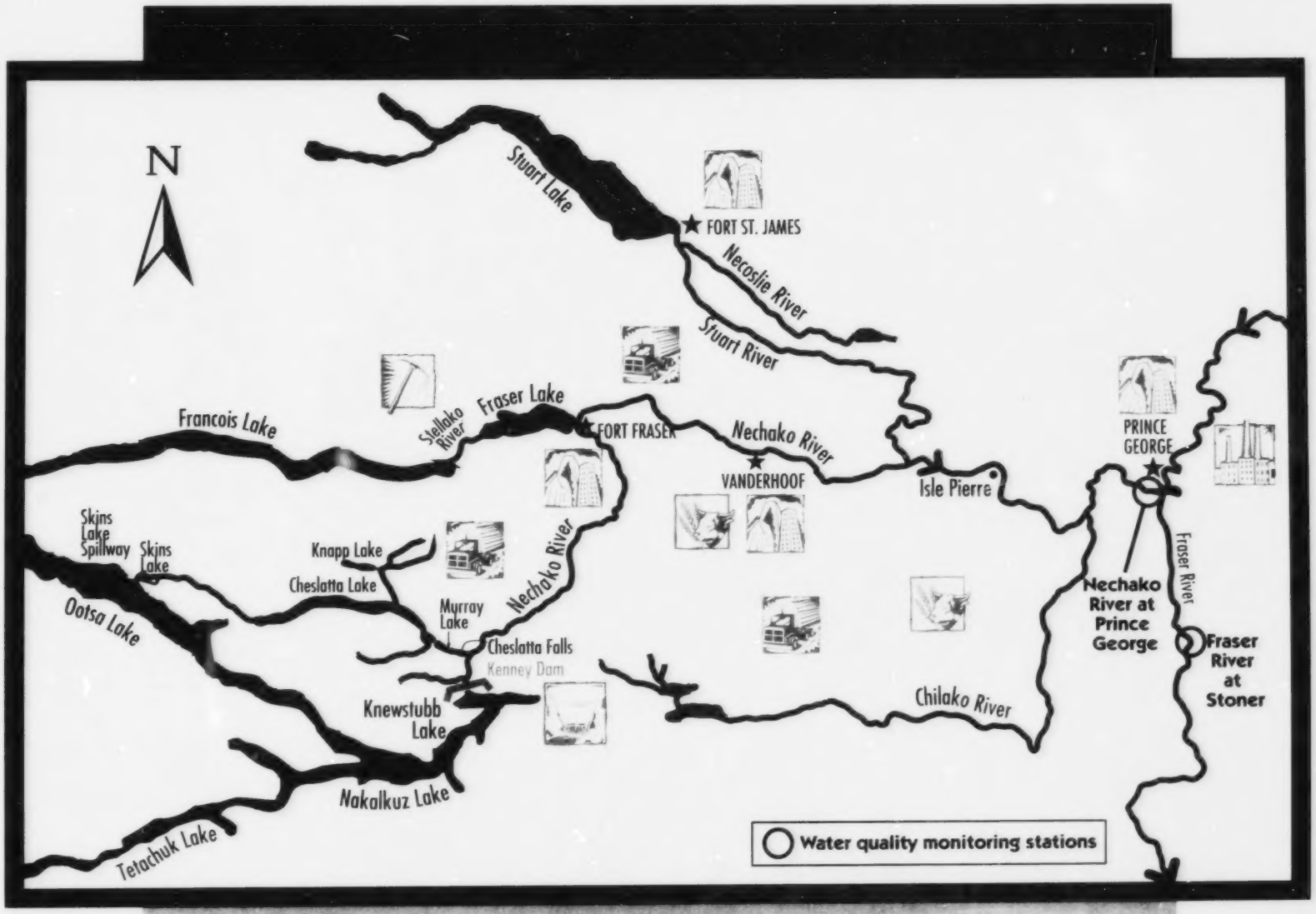
The objective for AOX was still not attained consistently at Stoner in 1996, but this is considered to be of low environmental significance because chlorinated phenols and dioxins and furans met the objectives in 1995. AOX is merely a surrogate indicator for these chlorinated compounds.

Are there other water quality concerns?

AOX was the only water quality indicator measured consistently at Stoner, and the 1996 B.C. Water Quality Status Report did not evaluate the water quality of the Fraser River above Hope. Thus, we do not have definitive information about any other water quality concerns. Occasional fecal coliform monitoring at Stoner and more extensive monitoring downstream at the Fraser River at Marguerite suggest that fecal contamination may also be a concern at Stoner. Additional information on environmental quality in the Fraser River watershed is available in the Environment Canada report, Health of the Fraser River Aquatic Ecosystem – A Synthesis of Research Conducted under the Fraser River Action Plan.

What will be done to further improve water quality?

Monitoring of AOX at the Fraser River at Stoner is continuing and monitoring of fecal coliforms has begun.



Nechako River Area

Nechako River at Prince George

What are the water quality trends?
There were no environmentally significant changes.

No changes

What are the main attributes of the Nechako River at Prince George?

The Nechako River drains about 46,000 km^2 of the interior plateau to the Fraser River at Prince George. The Nechako is used for irrigation, livestock watering, recreation, and drinking water, and sustains significant aquatic life and wildlife, including important salmon runs.

What are the main human influences on water quality?

The main influences on water quality are the Kenney Dam and the Nechako Reservoir, which divert water from the Nechako basin for the Kemano hydroelectric project and reduce river flows significantly. Other influences are treated sewage from Fort Fraser and Vanderhoof, agriculture and forestry.

What water quality indicators were monitored?

Major ions, trace elements, nutrients, colour, dissolved and suspended solids, pH, fecal coliforms, and temperature were monitored once every two weeks since 1985. Flow has been monitored continuously at Isle Pierre, 52 km upstream.

What are the water quality trends and what caused them?

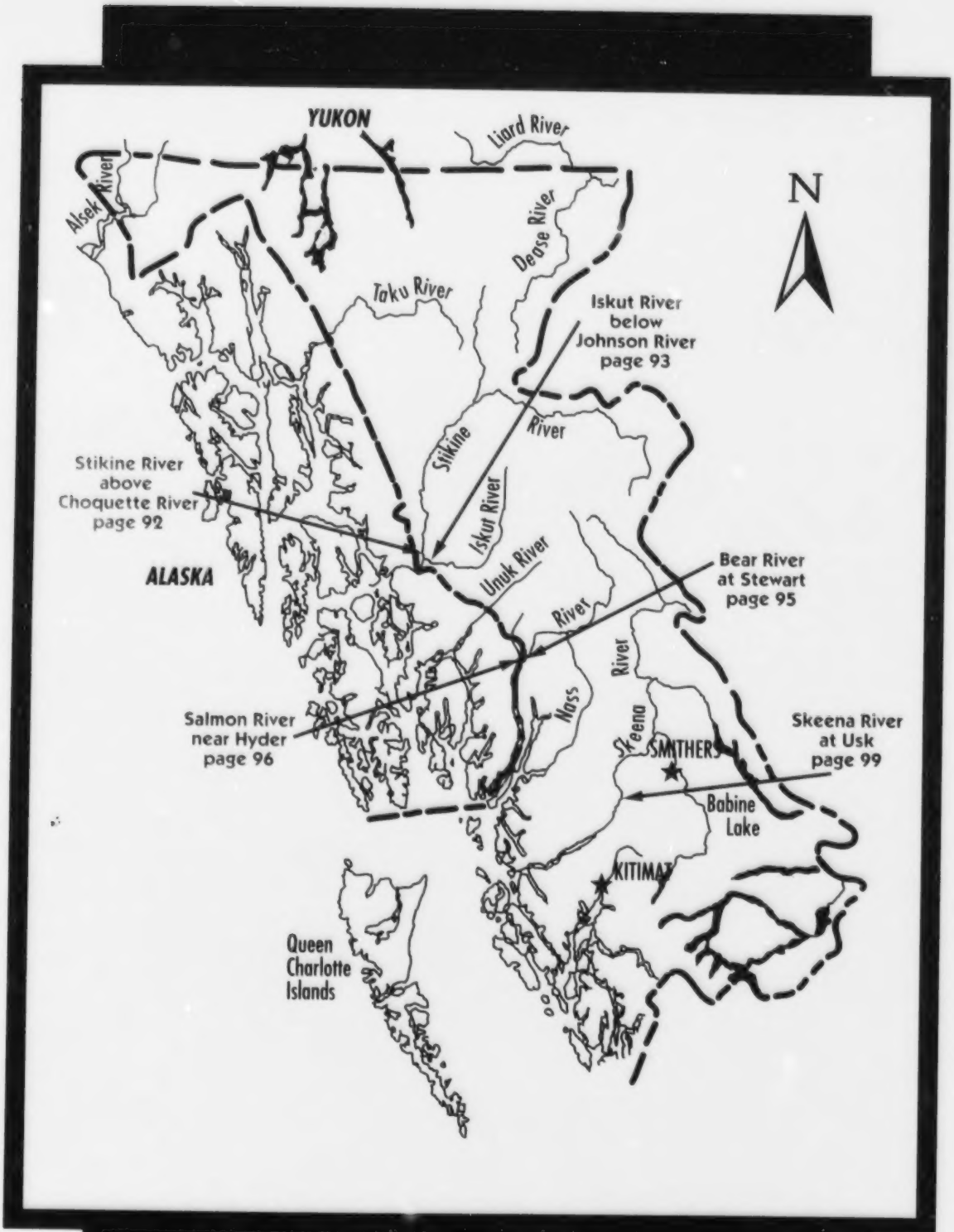
There were no environmentally significant changes from 1985 through 1995.

Are there any water quality concerns?

No. The 1996 B.C. Water Quality Status Report did not evaluate the water quality of the Nechako River downstream from the Stuart River. Additional information on environmental quality in the Nechako River watershed is available in the Environment Canada report, Health of the Fraser River Aquatic Ecosystem – A Synthesis of Research Conducted under the Fraser River Action Plan.

What will be done to maintain water quality?

Water quality monitoring is continuing on the Nechako River at Prince George to detect any trends.



Skeena Region

SKEENA REGION SUMMARY

The Skeena Region is located in the northwestern part of the Province, bordering the Yukon and Alaska. It extends from Babine Lake in the east to the Queen Charlotte Islands in the west, as shown on the map opposite. Most of the rivers in the region drain to the Pacific Ocean, often passing through the Alaska panhandle in their lower reaches. The major streams, from north to south, are the Alsek, Taku, Stikine, Iskut, Unuk, Nass and Skeena rivers. The main BC Environment regional office is located in Smithers.

There were seven long-term water quality monitoring stations in this Region; one each on the Alsek, Stikine, Iskut, Unuk, Salmon, Bear, and Skeena rivers. Four stations had no changes, while the Salmon River near Hyder, Alaska had improving trends in water quality. The Alsek and Unuk rivers did not yet have enough years of data for trend assessment and are not included in this report.

If you have any questions on the trend report or want more information on other waterbodies in the Region, please contact:

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Deteriorating Trends in Water Quality

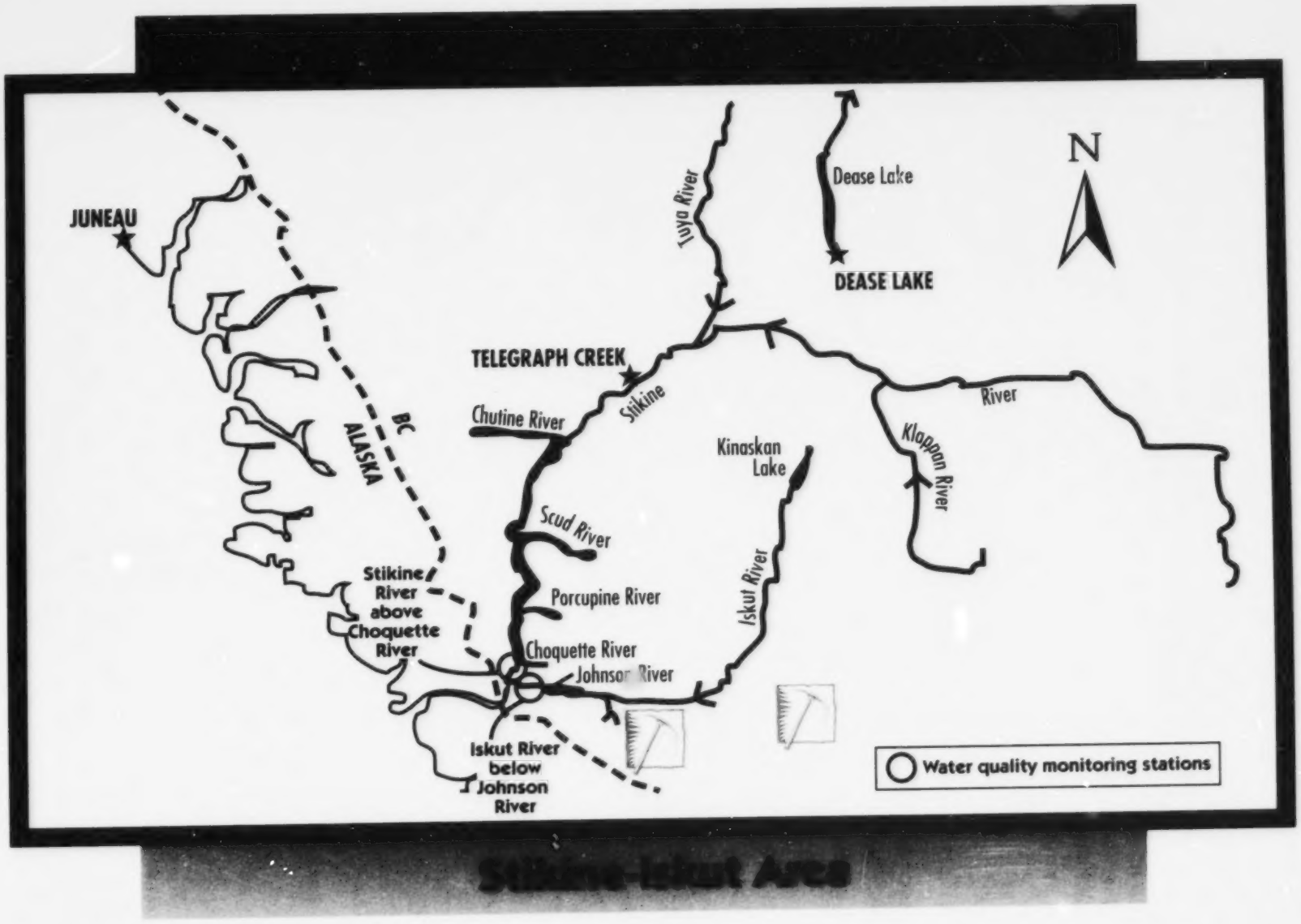
Location (Years)	Water Quality Indicators	Cause of Trend	Water Uses at Risk	Action
None				

Improving Trends in Water Quality

Location (Years)	Water Quality Indicators	Cause of Trend	Water Uses at Risk	Action
Salmon River near Hyder, Alaska (1990–97)	Cyanide	Uncertain	Aquatic life and wildlife	None required. Monitoring is continuing.

No Changes in Water Quality – Other Water Quality Concerns

Location (Years)	Water Quality Indicators	Concern	Water Uses at Risk	Action
Stikine River above Choquette River (1981–94)		None		None needed.
Iskut River below Johnson River (1981–94)		None		Monitoring is continuing.
Bear River at Stewart (1987–94)	Selenium	Often exceeded guidelines. May be natural or due to old mines.	Aquatic life	Survey of selenium sources will be done.
Salmon River near Hyder, Alaska (1990–97)	Selenium	Often exceeded guidelines. May be natural or due to old mines.	Aquatic life	Survey of selenium sources will be done. Monitoring is continuing.
Skeena River at Usk (1985–94)		None		Monitoring is continuing.



Stikine-Iskut Area

Stikine River above Choquette River

What are the water quality trends?
There were no environmentally significant changes.

No changes

What are the main attributes of the Stikine River above Choquette River?
The Stikine River above Choquette River drains about 42,250 km^2 of northern B.C. The water sampling station is located just upstream from the confluence with the Iskut River, which lies 12 km upstream from the Alaska – B.C. border. Together, the Stikine and Iskut rivers drain about 51,600 km^2 of B.C. into Alaska and the Pacific Ocean, and support important commercial salmon runs. The Stikine has been designated as a B.C. Heritage River, and nominated as a Canadian Heritage River.

What are the main human influences on water quality?
The main potential influences on water quality are mining and forestry, but the basin is lightly developed at present with relatively pristine water quality.

What water quality indicators were monitored?
Major ions, trace elements, nutrients, colour, dissolved and suspended solids, pH, and temperature were monitored about once every two months from 1981 to 1996. Flow was monitored continuously about 70 km upstream.

What are the water quality trends and what caused them?
There were no environmentally significant changes from 1981 through 1994.

Are there any other water quality concerns?
No. The water quality of the Stikine River was not evaluated in the 1996 B.C. Water Quality Status Report.

Does anything need to be done?
There were no environmentally significant changes or other water quality concerns at this time, and monitoring has been suspended.

Iskut River below Johnson River

What are the water quality trends?
There were no environmentally significant changes.

No changes

What are the main attributes of the Iskut River below Johnson River?

The Iskut River below Johnson River drains 9,350 km^2 of northern B.C. The water sampling station is located just upstream from the confluence with the Stikine River, which lies 12 km upstream from the Alaska – B.C. border. Together, the Stikine and Iskut rivers drain about 51,600 km^2 of B.C. into Alaska and the Pacific Ocean, and support important commercial salmon runs.

What are the main human influences on water quality?

The main potential influences on water quality are mines located south from the river. Forestry may also affect the river, but is not a major industry in the area at this time due to the remote location. In general, the basin is lightly developed with relatively pristine water quality.

What water quality indicators were monitored?

Major ions, trace elements, cyanide, nutrients, colour, dissolved and suspended solids, pH, and temperature were monitored about once every two months since 1981. Flow has been monitored continuously.

What are the water quality trends and what caused them?

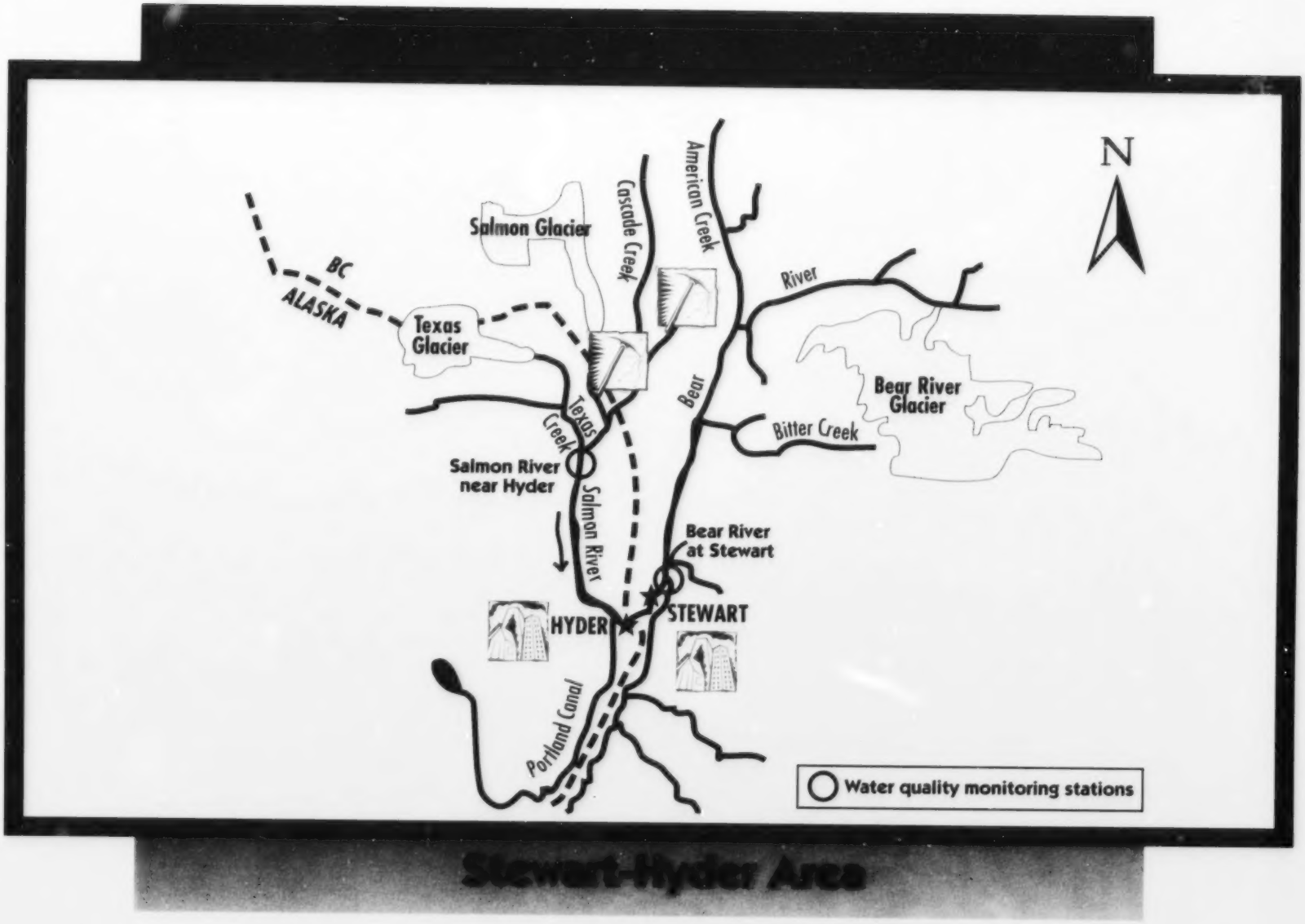
There were no environmentally significant changes from 1981 through 1994.

Are there any other water quality concerns?

Not at present. The water quality of the Iskut River was not evaluated in the 1996 B.C. Water Quality Status Report.

What will be done to maintain water quality?

There were no environmentally significant changes or other water quality concerns at this time. Monitoring is continuing because of the mining in the watershed.

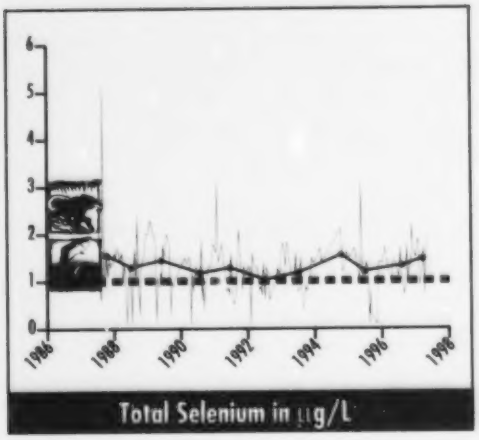


Stewart-Hyder Area

Bear River at Stewart

What are the water quality trends?
There were no environmentally significant changes.

No changes



Total Selenium in µg/L

What are the main attributes of the Bear River at Stewart?

The Bear River at Stewart drains 708 km^2 of the Coast Mountains in north central B.C. into the Portland Canal just upstream from the Alaska-B.C. border. The Bear River Glacier and other glaciers dominate the headwaters of the basin.

What are the main human influences on water quality?

The main potential influences on water quality are old mines in the headwaters of the basin, and highway 37A, which parallels the Bear River through the watershed. However, the basin is lightly populated and developed, and the glaciers have the major influence on water quality.

What water quality indicators were monitored?

Major ions, trace elements, nutrients, colour, dissolved and suspended solids, pH, and temperature were monitored about once every two weeks from 1987 to 1997 at the highway 37A bridge just upstream from Stewart. Flow has been monitored continuously 8 km upstream.

What are the water quality trends and what caused them?

There were no environmentally significant changes from 1987 through 1994.

Are there any other water quality concerns?

Selenium levels in the Bear River often exceeded the safe level for aquatic life and wildlife as shown in the graph. We suspect that this is a natural phenomenon due to the minerals in the area, because levels are similar in the adjacent Salmon River basin. However, there are old mines in the Bear River basin, which might be contributing selenium. The water quality of the Bear River was not evaluated in the 1996 B.C. Water Quality Status Report.

Does anything need to be done?

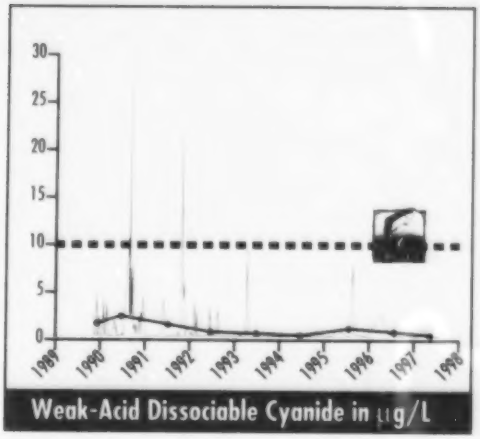
There were no environmentally significant changes, and regular monitoring was suspended in 1997. A survey will be done to identify the selenium sources in the basin and to determine whether a remediation plan is needed.

Salmon River near Hyder, Alaska

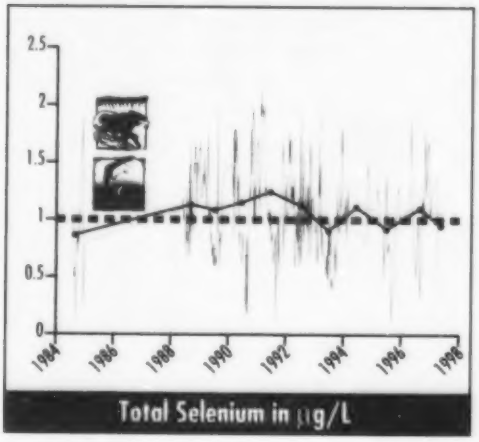
What are the water quality trends?

The Salmon River near Hyder had an improving trend in cyanide, but the cause of the trend is uncertain.

Improving trend



Weak-Acid Dissociable Cyanide in µg/L



Total Selenium in µg/L

What are the main attributes of the Salmon River near Hyder?

The Salmon River drains about 300 km^2 of the Coast Mountains in Alaska and north central B.C. into the Portland Canal at Hyder. The basin straddles the Alaska-B.C. border, with the Salmon River and Cascade Creek flowing from B.C., and Texas Creek flowing from Alaska. The three streams meet in Alaska just downstream from the border, and support important salmon runs. The Salmon and Texas glaciers dominate the headwaters of the basin.

What are the main influences on water quality?

The main potential influences on water quality are the active and old mines in the basin, but the glaciers are also a major influence.

What water quality indicators were monitored?

Major ions, trace elements, nutrients, colour, dissolved and suspended solids, pH, cyanide, fecal coliforms, and temperature were monitored downstream from Texas Creek once every one or two weeks during 1982-84 and since 1988. Flow has not been measured.

What are the water quality trends and what caused them?

Cyanide levels have declined since 1990, but the cause of the trend is uncertain. There have been mines in the basin that discharged cyanide, but we are unable to attribute the cyanide in the river to any source.

What is the environmental significance of the trends?

Cyanide levels have declined from levels that at times may have been harmful to aquatic life to levels that are now safe.

Are there any other water quality concerns?

Selenium levels in the Salmon River often exceeded the safe level for aquatic life and wildlife as shown in the graph. We suspect that this is a natural phenomenon due to the minerals in the area, because levels are similar in the adjacent Bear River basin. However, some old mines in the Salmon River basin may be discharging selenium. The Westmin Premier mine, which closed in 1996, was checked but found not to be a source of selenium. Zinc exceeded safe levels for aquatic life on a few

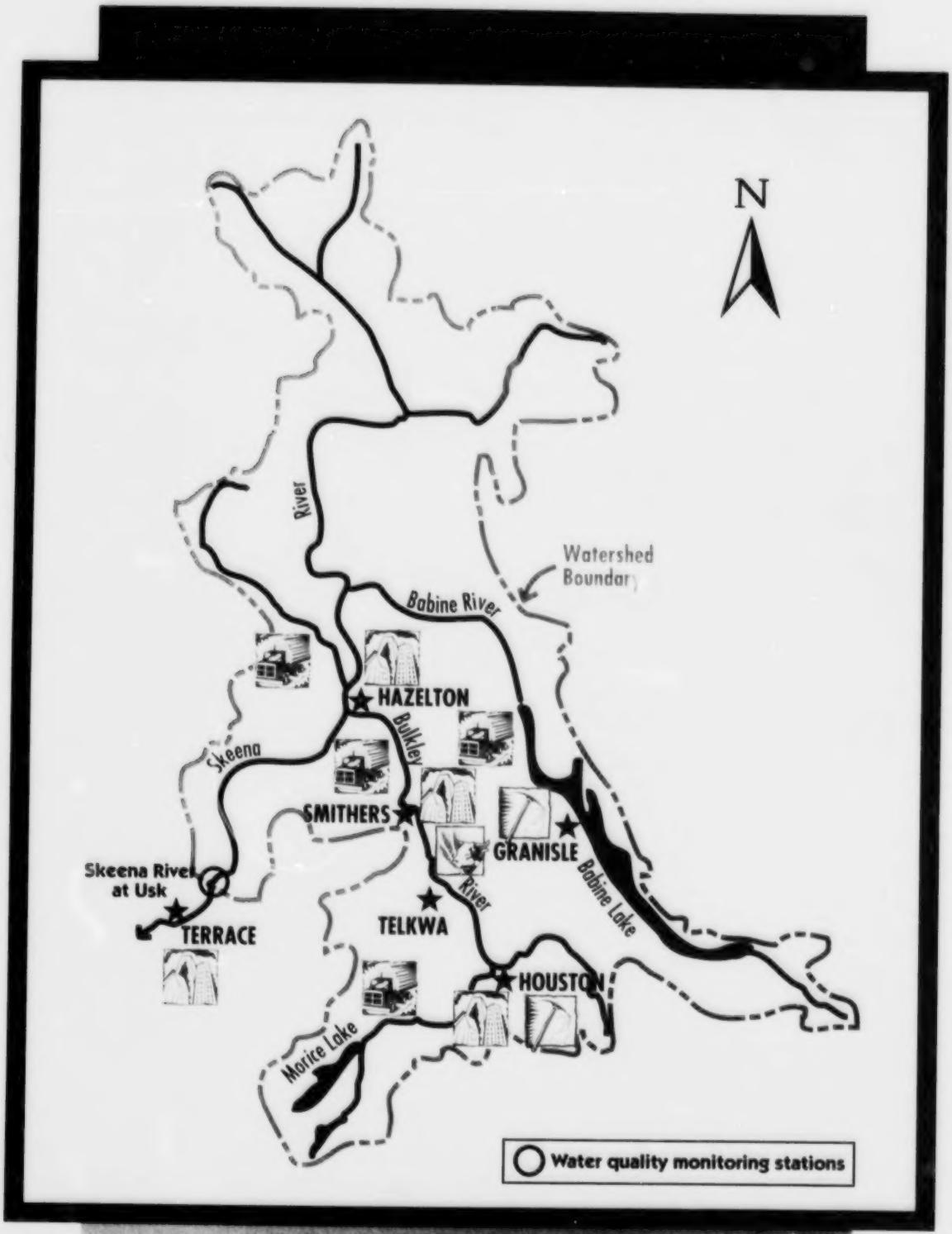
continued on next page

occasions during winter low flows, possibly due to zinc-rich drainage from old mines. A study of Cascade Creek downstream from the Westmin Premier mine concluded that elevated zinc levels due to the mine did not appear to have a detrimental effect on aquatic life.

The water quality of the Salmon River was not evaluated in the 1996 B.C. Water Quality Status Report.

Does anything need to be done?

A survey will be done to identify the selenium sources in the basin and to determine whether a remediation plan is needed. Monitoring of the Salmon River is continuing in view of drainage from the old mines and the potential for new or reopened mines in the basin.



Skeena River Basin

Skeena River at Usk

What are the water quality trends?
There were no environmentally significant changes.

No change

What are the main attributes of the Skeena River at Usk?

The Skeena River at Usk drains 42,200 km^2 of the Coast Mountains in north-central B.C., and supports major runs of salmon. Its major tributaries are the Bulkley and Babine rivers.

What are the main human influences on water quality?

The main potential influences on water quality are forestry, mining, agriculture and treated sewage from Houston, Telkwa, Smithers and Hazelton.

What water quality indicators were monitored?

Major ions, trace elements, nutrients, colour, dissolved and suspended solids, pH, and temperature were monitored once every two weeks since 1985 at the Usk ferry crossing of the Skeena River about 20 km upstream from Terrace. Flow has been monitored continuously.

What are the water quality trends and what caused them?

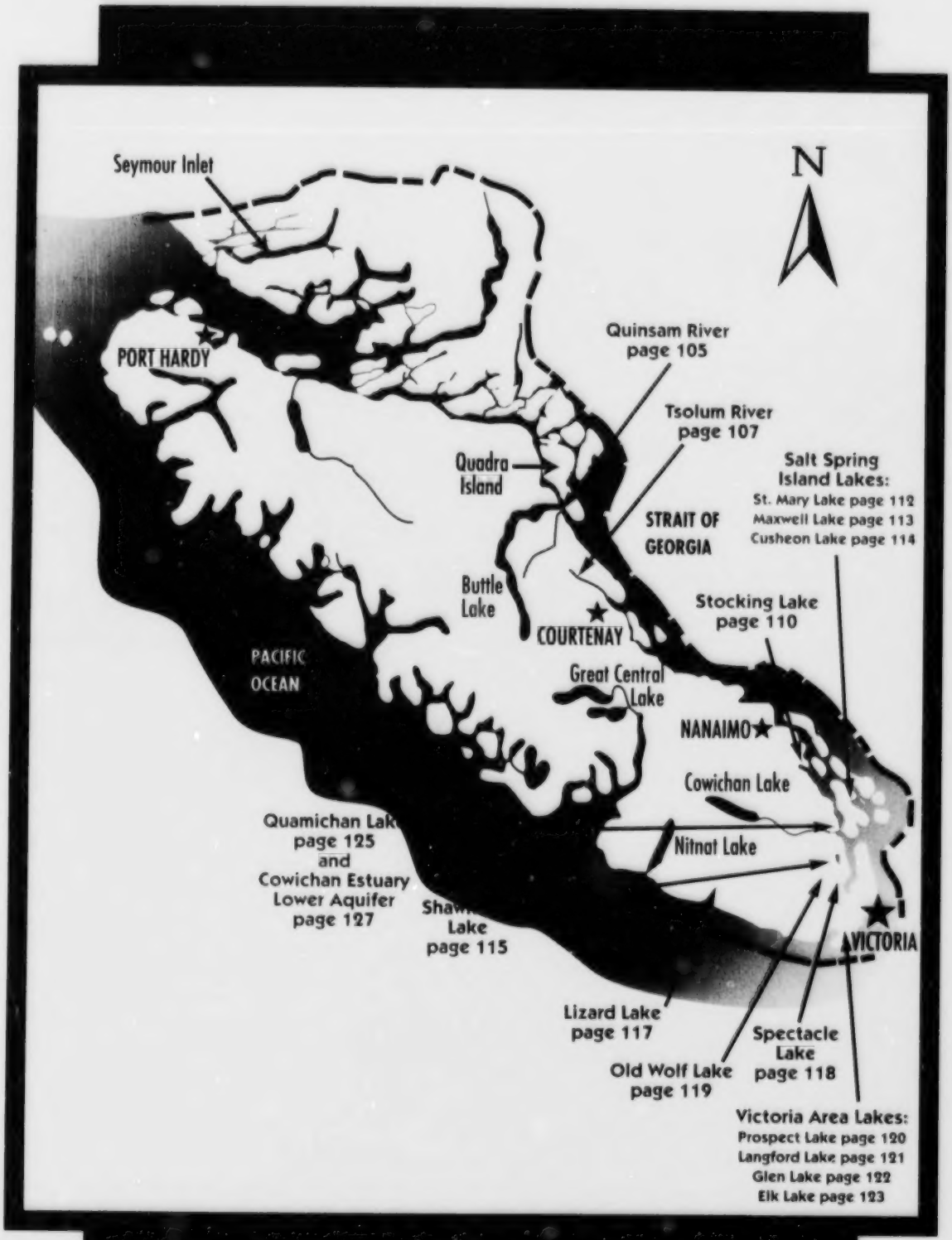
There were no environmentally significant changes from 1985 through 1994.

Are there any other water quality concerns?

No. The water quality of the Skeena River was not evaluated in the 1996 B.C. Water Quality Status Report.

What will be done to maintain water quality?

Environment Canada is continuing to monitor the Skeena River at Usk because it is a United Nations Global Environmental Monitoring Station (GEMS) for measuring the amount of substances entering the oceans.



Vancouver Island Region

VANCOUVER ISLAND REGION SUMMARY

The Vancouver Island Region includes all of the island plus part of the mainland coast from Seymour Inlet in the north to Quadra Island in the south, as shown on the map opposite. The main BC Environment regional office is located in Nanaimo.

Sixteen waterbodies had long-term water quality stations in this Region. There was one station on the Quinsam River and four in the Tsolum River basin, 13 lake stations on southern Vancouver Island and Salt Spring Island, and six wells in the Cowichan Estuary Lower Aquifer. The water quality trends in these waterbodies are summarized in the table below.

If you have any questions on the trend reports or want more information on other waterbodies in the Region, please contact:

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Deteriorating Trends in Water Quality

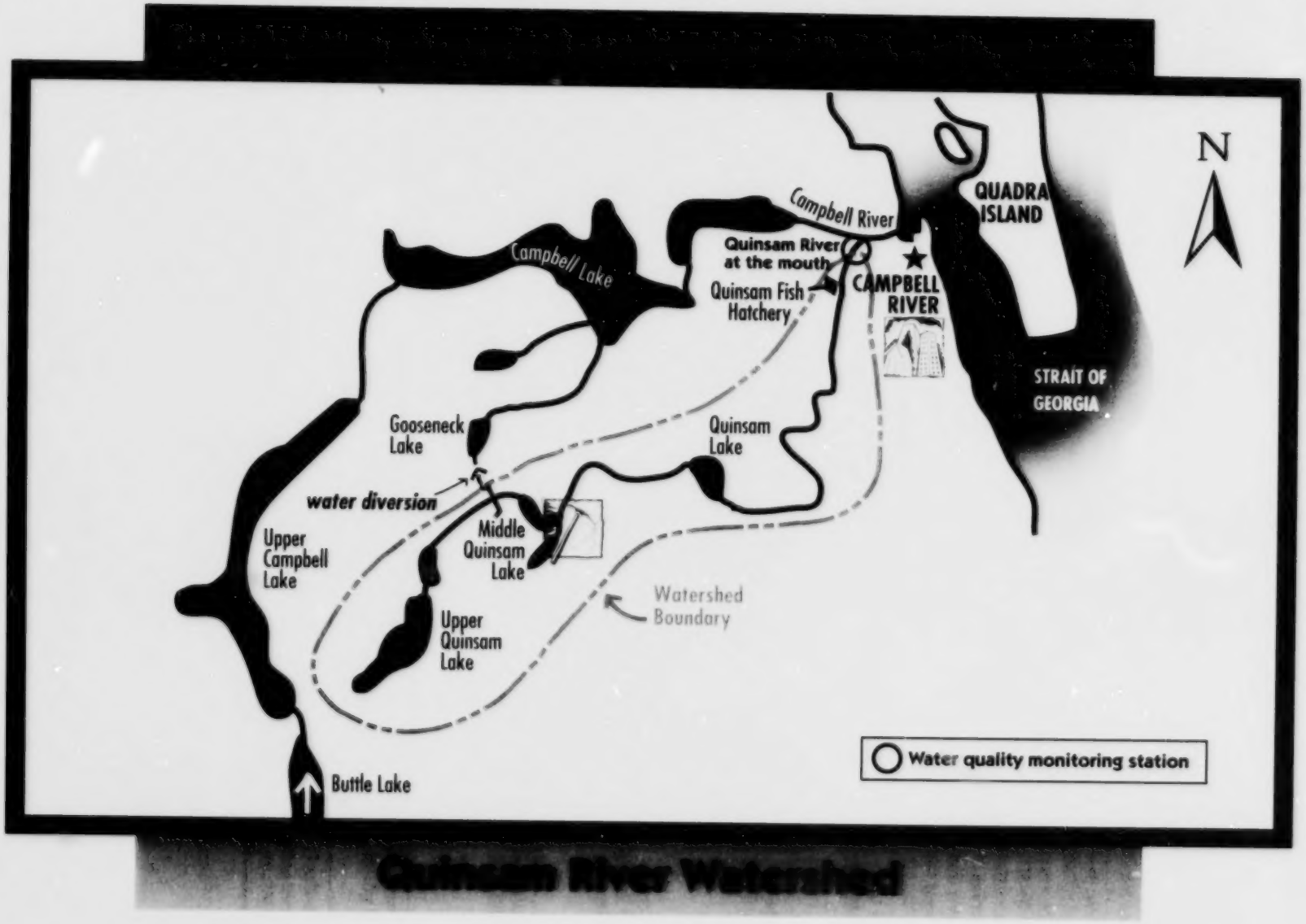
Location (Years)	Water Quality Indicators	Cause of Trend	Water Uses at Risk	Action
Quinsam River (1986–96)	Sulphate and other major ions	Coal mining	Aquatic life – potential effects, no direct threat at present	Investigation underway at coal mine. Monitoring is continuing.
Quamichan Lake (1973–97)	Fecal coliforms	Waterfowl	Recreation (swimming)	Remediation plan, expanded monitoring and stewardship needed. Basic monitoring is continuing.
Cowichan Estuary Lower Aquifer – 1 of 6 wells (1985–94)	Total dissolved solids	Local pumping of aquifer	Drinking water and irrigation	Monitoring has resumed and will report to local groups.

Improving Trends in Water Quality

Location (Years)	Water Quality Indicators	Cause of Trend	Water Uses at Risk	Action
Pyrrhotite Creek (Tsolum River basin) (1985–98)	Copper	Mine reclamation	Aquatic life	Continued reclamation and monitoring.
Stocking Lake (1985–95)	Phosphorus	Unknown	Drinking water	Monitoring is continuing.
Maxwell Lake (1985–95)	Phosphorus	Unknown	Drinking water	Monitoring is continuing.
Cowichan Estuary Lower Aquifer – 1 of 6 wells (1985–93)	Total dissolved solids	Uncertain	Drinking water and irrigation	Monitoring has resumed and will report to local groups.
Shawnigan Lake (1976–98)	Phosphorus	Unknown	Drinking water, aquatic life and recreation	Monitoring is continuing.
Lizard Lake (1985–95)	Phosphorus	Unknown	Aquatic life and recreation	Monitoring has resumed.
Spectacle Lake (1985–92)	Phosphorus	Unknown	Aquatic life and recreation	None needed.
Old Wolf Lake (1985–95)	Phosphorus	Unknown	Aquatic life and recreation	Monitoring is continuing.
Langford Lake (1979–98)	Phosphorus	Lake aeration and unknown	Aquatic life and recreation	A lake stewardship group has been formed and additional monitoring is being done. Aeration and basic monitoring are continuing.

No Changes in Water Quality – Other Water Quality Concerns

Location (Years)	Water Quality Indicators	Concern	Water Uses at Risk	Action
Tsolum River 500 m downstream from Murex Creek (1989–97) Tsolum River at Farnham (1987–94) Murex Creek at Duncan Main (1986–97)	Copper	Drainage from mine on Mt Washington is toxic to fish	Aquatic life	Tsolum River Task Force is leading remediation. Monitoring is continuing.
Elk Lake (1983–98)	Phosphorus, Dissolved oxygen, Algae	Eutrophication	Aquatic life and recreation	Basic monitoring is continuing. Watershed planning, remediation and expanded monitoring are desirable.
Glen Lake (1981–98)	Phosphorus, Dissolved oxygen, Fecal coliforms	Eutrophication Fecal contamination	Aquatic life and recreation	Basic monitoring is continuing. Watershed planning, remediation and expanded monitoring are desirable. The lake aerator needs to be replaced.
St. Mary Lake (1974–98)	Phosphorus	Eutrophication	Drinking water, aquatic life and recreation	Basic monitoring is continuing. Watershed planning, remediation and expanded monitoring are desirable.
Cusheon Lake (1974–98)	Phosphorus	Eutrophication	Drinking water, aquatic life and recreation	Basic monitoring is continuing. BC Environment will support the local stewardship group in monitoring and watershed management planning.
Prospect Lake (1980–98)	Phosphorus Fecal coliforms	Eutrophication Fecal contamination	Drinking water, aquatic life and recreation	Watershed planning is underway. Monitoring is continuing.
Cowichan Estuary Lower Aquifer – 4 of 6 wells (1985–93)		None		Monitoring will resume at key wells.

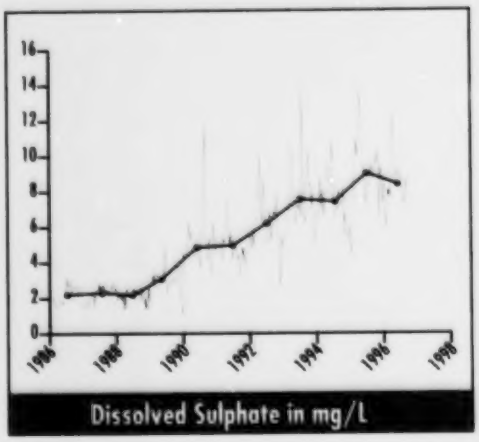


Quinsam River Watershed

What are the water quality trends?

There were deteriorating trends in sulphate and other major ions at the mouth of the Quinsam River due to the coal mine at Middle Quinsam Lake. These trends are not a direct threat to aquatic life at present, and are being addressed through additional monitoring near the mine.

Deteriorating trend



Dissolved Sulphate in mg/L

What are the main attributes of the Quinsam River?

The Quinsam River drains 280 km^2 of the east coast of Vancouver Island to the Campbell River 3 km upstream from the Strait of Georgia. The river is used for irrigation, recreation, and fish hatchery water supply, and is a potential drinking water source for Campbell River. The river supports a wide variety of wild salmonids, as well as salmonids raised at the Quinsam Fish Hatchery.

What are the main human influences on water quality?

These include coal mining at Middle Quinsam Lake, which began in late 1987, logging, fish hatchery wastewater, and the diversion of water for hydro-electric power generation on the Campbell River.

What water quality indicators were monitored?

Major ions, trace elements, nutrients, colour, dissolved and suspended solids, pH, and temperature have been monitored once every two weeks since 1986 at the Highway #28 bridge near the mouth of the Quinsam River. Flow has been monitored continuously at the same location.

What are the water quality trends and what caused them?

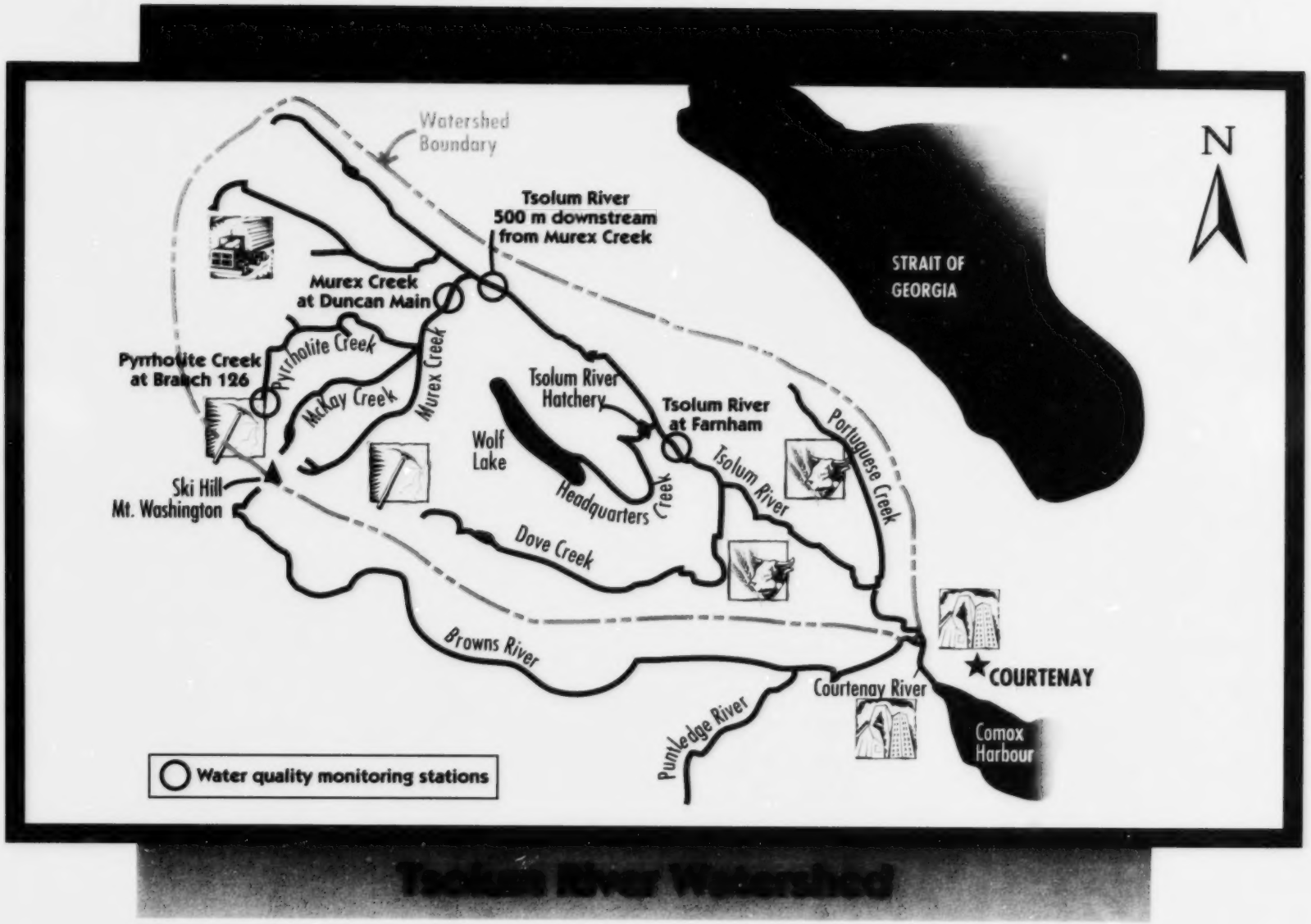
Major ions such as sulphate, calcium, magnesium, sodium, and strontium, and the related indicators of hardness and conductivity, showed increasing trends at the mouth of the Quinsam River, starting in 1989 to 1992, depending on the indicator. The cause is the coal mine at Middle Quinsam Lake.

What is the environmental significance of the trends?

The increasing levels of water quality indicators at the mouth of the Quinsam River were well below the safe levels for all water uses. However, the sulphate levels upstream near the coal mine were much higher and may pose a risk to aquatic life, although no effects on aquatic life have been observed. There is no evidence to date of acidification of the waters near the mine. The 1996 B.C. Water Quality Status Report rated the water quality of Middle Quinsam Lake as excellent and the Quinsam River as good, using monitoring results collected to 1993, but it did not include results for the indicators with increasing trends.

What is being done?

Studies have been done near the coal mine, and the coal mining company has been advised to identify and control sulphate discharges from the mine. Monitoring is continuing near the mine and at the mouth of the Quinsam River to track the trends in water quality. BC Environment is also developing new water quality guidelines for sulphate to enable better evaluation of the sulphate levels.



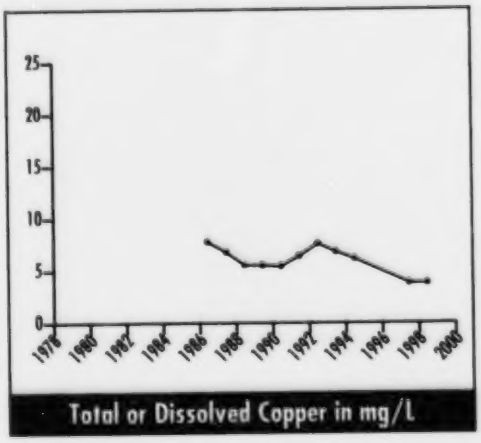
Tsolum River Watershed

Tsolum River

What are the water quality trends?

In the mid 1980's, it was shown that toxic copper concentrations from an abandoned mine had been largely responsible for eliminating the fisheries in the Tsolum River. There has been about a 50% decline in copper loadings from the mine since the late 1980's, but copper levels in the Tsolum River continue to reach toxic levels.

Improving trend



Pyrrhotite Creek at Branch 126

What are the main attributes of the Tsolum River?

The Tsolum River drains 258 km^2 of the east coast of Vancouver Island, joining the Puntledge River to form the Courtenay River, 1.5 km upstream from Comox Harbour on the Strait of Georgia. The river is used for irrigation, recreation, and drinking water. The river has supported large populations of steelhead, rainbow, and cutthroat trout and coho, pink and chum salmon in the past. However, there are virtually no escapements at present. Pink salmon are raised at the Tsolum River Hatchery on Headquarters Creek.

What are the main human influences on water quality?

A number of human activities influence water quality in the Tsolum River basin to varying degrees. They include logging in the headwaters and upper watershed, road development, irrigation withdrawals and agriculture. However, the most significant impact on water quality is an abandoned mine on Mt. Washington. Copper is leaching from the mine via Pyrrhotite and Murex creeks, causing the levels in the Tsolum River to exceed the objectives for aquatic life much of the time.

What water quality indicators were monitored?

Major ions, trace elements, pH and acidity have been monitored since 1985 in Pyrrhotite Creek, Murex Creek, and the Tsolum River at Farnham. Monitoring began in the Tsolum River 500 m downstream from Murex Creek in 1989. Since 1995, monitoring has largely focused on copper, which has been monitored weekly in the spring and fall and monthly through the rest of the year. The primary monitoring stations are now located in the Tsolum River 500 m downstream from Murex Creek and in Pyrrhotite Creek just downstream from the mine. Flows have been monitored at these two sites since spring 1997. Additional flow monitoring has taken place since 1964 at the Tsolum River near Courtenay.

What are the water quality trends and what caused them?

There was a declining trend in copper levels in Pyrrhotite Creek at Branch 126 as shown in the graph opposite. This trend was not detected at the stations farther downstream in Murex Creek and the Tsolum River, probably due to gaps in the copper data. In 1998,

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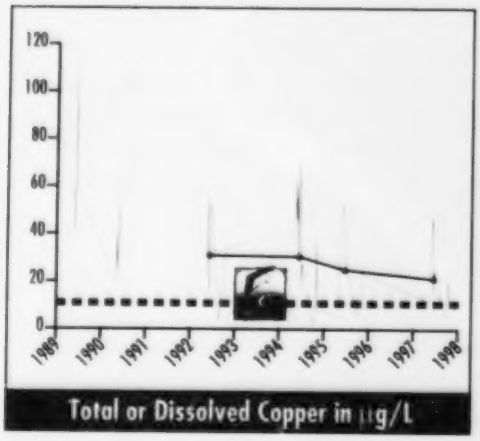
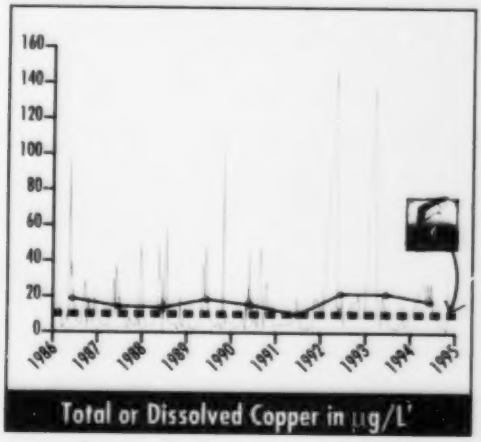


Tsolum River 500 m downstream from Murex Creek



Tsolum River at Farnham

there was about a 50% decrease in copper loadings relative to the late 1980's. The provincial government spent $1.5 million during 1988–91 to control acid mine drainage by capping portions of the mine waste and diverting some of the surface water away from the mine.

What is the environmental significance of the trends?

Levels of copper in the Tsolum River peak in the spring and fall and tend to exceed the objectives for much of the year as shown in the graphs for the Tsolum River 500 m downstream from Murex Creek and at Farnham. The high concentrations of copper have been shown to be toxic to fish and have virtually eliminated the fish population throughout the river. Studies have shown that re-establishment of fisheries in the Tsolum River would require greater than a 95% decrease in copper loadings from the mine.

Are there any other water quality concerns?

While the main concern is copper, other concerns include low summer flows and elevated suspended solids during high flows. The water quality of the Tsolum River was not evaluated in the 1996 B.C. Water Quality Status Report, because the water quality objectives for the Tsolum were approved in 1995 and their attainment had not yet been evaluated.

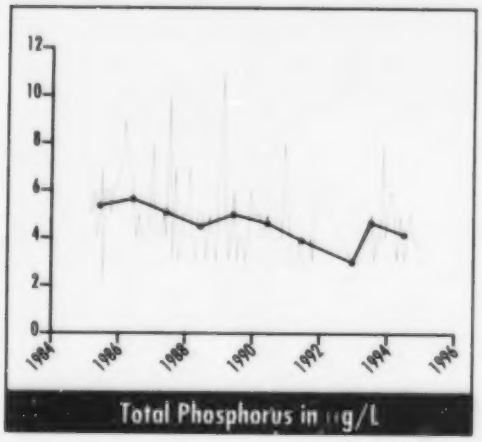
What is being done to improve water quality? The provincial government spent $1.5 million during 1988–91 to control acid mine drainage by capping the mine waste and diverting surface waters away from the mine. Copper loadings from the mine have declined, but high copper levels continue to limit fisheries production in the Tsolum River. The community-based Tsolum River Task Force was formed in 1997 to bring together various government and non-government organizations to increase community involvement in finding solutions to the Tsolum's problems. This approach has resulted in a number of initiatives, including increased monitoring of flows and copper throughout the watershed, and habitat restoration in the lower watershed funded by Fisheries and Oceans Canada. However, funding for major mine reclamation is not yet in place, and continues to be pursued.

Southern Vancouver Island and Salt Spring Island

Stocking Lake

What are the water quality trends?
There was an improving trend in total phosphorus due to unknown factors.

Improving trend



Total Phosphorus in µg/L

What are the main attributes of Stocking Lake?

Stocking Lake is a small lake with a surface area of 0.23 km^2, draining 1.65 km^2 of the east coast of Vancouver Island just south from Ladysmith. The lake is primarily used as a drinking water supply for Ladysmith and the adjacent Cowichan Valley Regional District. The lake was stocked with rainbow trout until 1986, when access to the lake was closed to protect the drinking water supply. It is one of six highly sensitive lakes in southwestern B.C. monitored to determine if there were any measurable effects due to acidic inputs from the atmosphere (e.g., rain, snow and dustfall). The lake is acid-sensitive because it has a small watershed and the land and water have a relatively low capacity to absorb acids.

What are the main human influences on water quality?

Inputs of acids and other contaminants from the atmosphere are the main influences.

What water quality indicators were monitored?

Lake water was analysed once every month during 1985-95 for major ions, trace metals, nutrients, pH, alkalinity, hardness, dissolved and suspended solids, and colour. Phytoplankton and zooplankton (tiny aquatic plants and animals) were sampled once per month from May to October during 1985–94 to determine the numbers and kinds present. The large plants in the lake were surveyed in 1985 and 1989.

What are the water quality trends and what caused them?

There was a declining trend in total phosphorus from 1985 to 1995. We don't know the cause of this trend, but similar declining trends in phosphorus were observed in half of the small lakes monitored in southwestern B.C.

What is the environmental significance of the trend?

The low and declining levels of phosphorus in the lake should minimize algal growth in the lake and prevent taste, odour and disinfection by-product concerns for drinking water use. The phosphorus levels are below the optimum levels for fish production, but the lake is no longer used for fishing in order to protect the drinking water supply.

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Are there any other water quality concerns?

No. The water quality of Stocking Lake was not evaluated in the 1996 B.C. Water Quality Status Report.

What is being done?

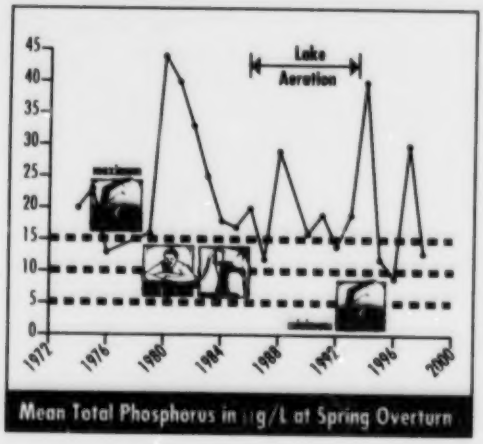
Monthly monitoring was suspended in 1995 because no water quality concerns were evident. A 10-year baseline of data has been collected, which can be used to check for changes in the future if there are concerns about acidification. Annual monitoring at spring overturn is being done to track trends in phosphorus, and the phenomenon of declining lake phosphorus is being investigated.

St. Mary Lake

What are the water quality trends?

There were no environmentally significant changes. Phosphorus levels were high in most years and should be reduced to improve water quality.

No changes



Mean Total Phosphorus in µg/L at Spring Overturn

What are the main attributes of St. Mary Lake?

St. Mary Lake is a small lake with a surface area of 1.8 km^2, draining 7.1 km^2 of northern Salt Spring Island. The lake is used as a drinking water supply, for recreation, and supports a sports fishery.

What are the main influences on water quality?

These include non-point sources of contaminants from residential development, including land clearing, road building, and septic tank-tile field effluents. The sediments on the bottom of the lake are a major source of phosphorus for algae in the lake. An aerator was installed and operated during 1986-93 to try to prevent phosphorus release from the sediments and to increase the amount of deep water fish habitat. The aerator was removed in 1993 because it had deteriorated and there were insufficient funds available to repair and operate it.

What water quality indicators were monitored?

Lake water has been sampled once per year for most years since 1974 during spring overturn when the lake water was well mixed. Nutrients, pH, calcium, magnesium, hardness, conductivity, colour, and temperature were measured. Other indicators such as turbidity, silicon, carbon, chlorophyll a, and dissolved oxygen were measured less regularly. Fecal coliform levels at beaches were monitored by the Capital Health Region during the spring and summer swimming seasons for most years from 1980 to the present.

What are the water quality trends and what caused them?

There were no environmentally significant changes from 1974 to 1998. Phosphorus levels varied widely as shown in the graph, but there was no evidence of a trend over time.

Are there any water quality concerns?

St. Mary Lake had relatively high levels of phosphorus at spring overturn, exceeding the guidelines for drinking water, recreation and aquatic life in most years. Phosphorus reduction is desirable to improve drinking water, recreation and the habitat for aquatic life. The water quality of St. Mary Lake was not evaluated in the 1996 B.C. Water Quality Status Report.

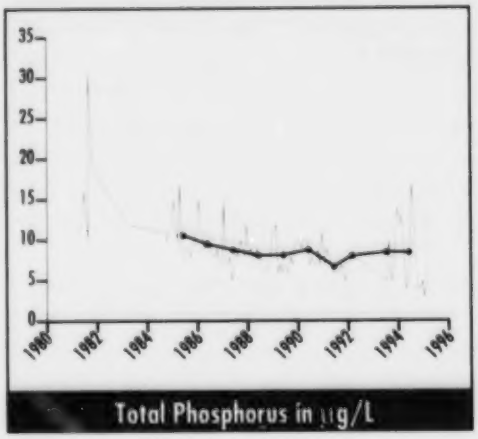
Does anything need to be done?

Yes. More intensive monitoring and the development of a remediation plan to improve the water quality of the lake has been recommended. A lake stewardship group should be formed to lead these activities. Limited monitoring is continuing at spring overturn to track long-term trends, and monitoring of fecal contamination at one beach in the summer is also continuing.

Maxwell Lake

What are the water quality trends?
There was an improving trend in total phosphorus due to unknown factors.

Improving trend



Total Phosphorus in µg/L

What are the main attributes of Maxwell Lake?

Maxwell Lake is a small lake with a surface area of 0.28 km^2, draining 1.2 km^2 of Mount Maxwell on Salt Spring Island. The lake is primarily used as a drinking water supply for the residents of North Salt Spring Island. The lake was stocked with rainbow trout in 1949 and 1984. It is one of six highly sensitive lakes in southwestern B.C. monitored to determine if there were any measurable effects due to acidic inputs from the atmosphere (e.g., rain, snow and dustfall). The lake is acid-sensitive because it has a small watershed and the land and water have a relatively low capacity to absorb acids.

What are the main human influences on water quality?

Inputs of acids and other contaminants from the atmosphere are the main influences. There is only one residence within the watershed, and access is controlled to protect the drinking water supply. The perimeter of the lake was cleared in 1992 and a dam was installed in 1994 to raise the lake level by 1 metre to increase the water storage capacity for the North Salt Spring Waterworks District.

What water quality indicators were monitored?

Lake water was analysed once every month during 1985–95 for major ions, trace metals, nutrients, pH, alkalinity, hardness, dissolved and suspended solids, and colour. Phytoplankton and zooplankton (tiny aquatic plants and animals) were sampled once per month from May to October during 1984–94 to determine the numbers and kinds present. The large plants in the lake were surveyed in 1985 and 1989.

What are the water quality trends and what caused them?

There was a declining trend in total phosphorus from 1985 to 1995. We don't know the cause of this trend, but similar declining trends in phosphorus were observed in half of the small lakes monitored in southwestern B.C.

What is the environmental significance of the trend?

The declining levels of phosphorus in the lake should minimize algal growth and prevent taste, odour and disinfection by-product concerns for drinking water use.

Are there any other water quality concerns?

No. The water quality of Maxwell Lake was not evaluated in the 1996 B.C. Water Quality Status Report.

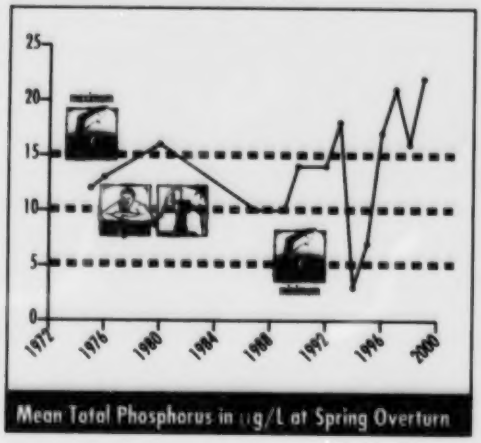
What is being done?

Monthly monitoring was suspended in 1995 because no water quality concerns were evident. A 10-year baseline of data has been collected, which can be used to check for changes in the future if there are concerns about acidification. Annual monitoring at spring overturn is continuing to track phosphorus trends, and the phenomenon of declining lake phosphorus is being investigated.

Cusheon Lake

What are the water quality trends?
There were no environmentally significant changes. Phosphorus levels were high in most years and should be reduced to improve water quality.

No changes



Mean Total Phosphorus in µg/L at Spring Overturn

What are the main attributes of Cusheon Lake?
Cusheon Lake is a small lake with a surface area of 0.27 km^2, draining 7.24 km^2 of southeastern Salt Spring Island. The lake is used as a drinking water supply, for recreation and irrigation, and supports a sports fishery.

What are the main influences on water quality?
Non-point sources of contaminants from residential development, including land clearing, road building, and septic tank-tile field effluents, agriculture, a golf course and a closed landfill are the main influences. Allegations that high winter lake levels affect the septic systems of some homes are being investigated.

What water quality indicators were monitored?
Lake water has been sampled once per year for about one-half of the years since 1974 during spring overturn when the lake water was well mixed. Nutrients, pH, conductivity, and temperature were measured. Other indicators such as major ions, metals, turbidity, carbon, chlorophyll a, colour, and dissolved oxygen were measured less regularly. Fecal coliform levels at beaches were monitored by the Capital Health Region during the spring and summer swimming seasons for most years from 1981 to the present.

What are the water quality trends and what caused them?
There were no environmentally significant changes from 1974 to 1999, although there was weak evidence (i.e. 90% confidence level) of an increasing trend in total phosphorus.

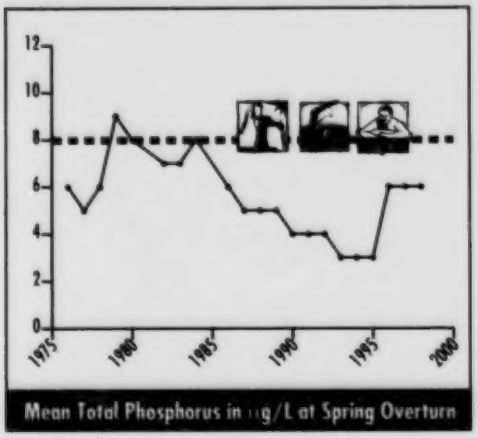
Are there any water quality concerns?
Cusheon Lake had relatively high levels of phosphorus at spring overturn, exceeding the guidelines for drinking water, recreation and aquatic life in most years. A blue-green algal bloom occurred in the summer of 1999, resulting in the issuance of a temporary precautionary health notice recommending that the lake not be used for drinking water. Phosphorus reduction is desirable to improve drinking water, recreation and the habitat for aquatic life. The public is concerned about sewage contamination from septic tanks. The water quality of Cusheon Lake was not evaluated in the 1996 B.C. Water Quality Status Report.

What is being done? Continued and expanded monitoring is needed to determine the present state of water quality in the lake, and to identify and evaluate remediation options to improve water quality in the lake for drinking, recreation, and fisheries. A stewardship group has been formed, and BC Environment will support the group in monitoring and watershed management planning. Monitoring is continuing at spring overturn to track long-term trends and for fecal contamination at the beach in summer. The Capital Health Region has been monitoring the lake for possible blue-green algal toxins since the fall of 1999.

Shawnigan Lake

What are the water quality trends?
Shawnigan Lake had an improving trend in phosphorus due to unknown factors.

Improving trend



Mean Total Phosphorus in µg/L at Spring Overturn

What are the main attributes of Shawnigan Lake?

Shawnigan Lake is a medium-sized lake with a surface area of 5.4 km^2, draining 69.4 km^2 of the southeast coast of Vancouver Island west from Mill Bay. The lake is used as a drinking water supply, for recreation, and supports a sports fishery.

What are the main influences on water quality?

Non-point sources of contaminants from residential development, including land clearing, road building, and septic tank-tile field effluents, and waterfowl are the main influences.

What water quality indicators were monitored?

Lake water has been sampled once per year for most years since 1976 during spring overturn when the lake water was well mixed. Nutrients were measured. Other indicators such as turbidity, pH, major ions, metals, conductivity, colour, temperature, carbon, chlorophyll a, and dissolved oxygen were measured less regularly. Fecal coliforms were measured by the Central Vancouver Island Health Unit at the beaches once per week for one to two months during the summer swimming season since 1988. The Cowichan Valley Regional District and BC Environment measured fecal coliforms near drinking water intakes once per week for one month during the summers of 1995 to 1997.

What are the water quality trends and what caused them?

There was a declining trend in phosphorus in the lake over the last 20 years. Levels have increased slightly during 1996–98, but not enough to alter the 20-year declining trend. We don't know the cause of the declining trend, but similar declining trends were observed in half of the lakes monitored in southwestern B.C.

What is the environmental significance of the trend?

Less phosphorus in the lake should result in reduced algal growth, making the water better for drinking water and recreation. The phosphorus guideline for Shawnigan Lake to protect drinking water, recreation and aquatic life was attained in every year but one.

continued on next page

Are there any other water quality concerns?

Fecal contamination was relatively low throughout the lake, and the water was normally safe for swimming. However, the beach at West Shawnigan Lake Provincial Park had to be closed during the summer of 1999 due to high fecal coliform counts due to geese. Also, in a few near-shore areas in the northern part of the lake, fecal contamination was such that the water should be filtered and disinfected before drinking. The water quality of the lake was not evaluated in the 1996 B.C. Water Quality Status Report.

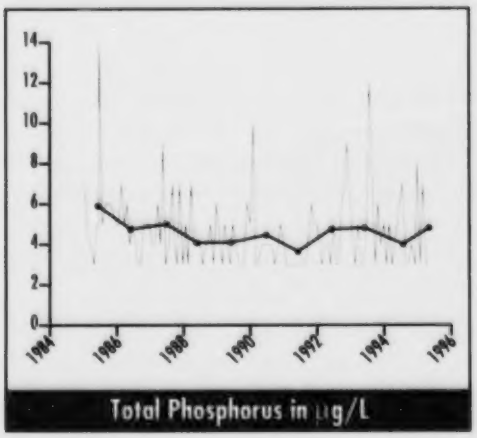
What is being done?

The Cowichan Valley Regional District's South Sector Liquid Waste Management Plan calls for the sewering of the shoreline of Shawnigan Lake, with sewage treatment and disposal to marine waters or agricultural lands. Monitoring is continuing at spring overturn to track the trends in nutrients in the lake, and for fecal contamination at the beaches in summer. The phenomenon of declining phosphorus levels in lakes is being investigated. More intensive monitoring of the lake during summer is desirable, and a lake stewardship group should be encouraged to implement this monitoring.

Lizard Lake

What are the water quality trends?
There was an improving trend in total phosphorus due to unknown factors.

Improving trend



Total Phosphorus in µg/L

What are the main attributes of Lizard Lake?
Lizard Lake is a small lake with a surface area of 8.7 hectares, and is located on the southwestern coast of Vancouver Island near Port Renfrew. The lake is used for recreation, and has been regularly stocked with rainbow trout. It is one of six highly sensitive lakes in southwestern B.C. monitored to determine if there were any measurable effects due to acidic inputs from the atmosphere (e.g., rain, snow and dustfall). The lake is acid-sensitive because it has a small watershed and the land and water have a relatively low capacity to absorb acids.

What are the main human influences on water quality?
Inputs of acids and other contaminants from the atmosphere are the main influences. In addition, most of the watershed has been logged and the entire shoreline is covered with log debris.

What water quality indicators were monitored?
Lake water was analysed once every month during 1985–95 for major ions, trace metals, nutrients, pH, alkalinity, hardness, dissolved and suspended solids, and colour. Phytoplankton and zooplankton (tiny aquatic plants and animals) were sampled once per month from May to October during 1984-94 to determine the numbers and kinds present. The large plants in the lake were surveyed in 1985 and 1989.

What are the water quality trends and what caused them?
There was a declining trend in total phosphorus from 1985 to 1995. We don't know the cause of this trend, but similar declining trends in phosphorus were observed in half of the small lakes monitored in southwestern B.C.

What is the environmental significance of the trend?
The declining levels of phosphorus in the lake should minimize algal growth and make the lake more aesthetically appealing for recreation. However, if phosphorus levels become too low, the lake could become biologically unproductive.

Are there any other water quality concerns?
No. The water quality of Lizard Lake was not evaluated in the 1996 B.C. Water Quality Status Report.

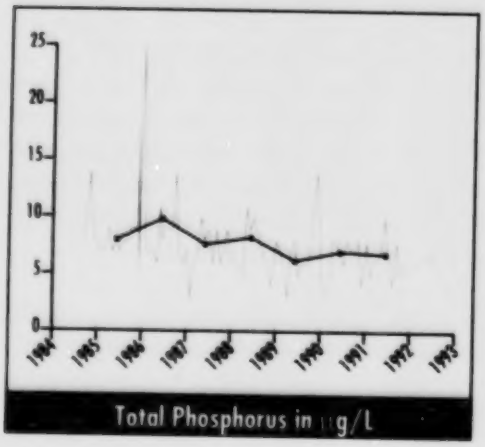
What is being done?
Monthly monitoring was suspended in 1995 because no water quality concerns were evident. A 10-year baseline of data has been collected, which can be used to check for changes in the future if there are concerns about acidification. Annual monitoring at spring overturn is being done to track phosphorus trends and the phenomenon of declining lake phosphorus is being investigated.

Spectacle Lake

What are the water quality trends?

There was an improving trend in total phosphorus due to unknown factors.

Improving trend



Total Phosphorus in µg/L

What are the main attributes of Spectacle Lake?

Spectacle Lake is a small lake with a surface area of 4 hectares, draining 6.2 km^2 of the Malahat Ridge northwest from Victoria. The lake is located in Spectacle Lake Provincial Park and is used for recreation. The lake has been regularly stocked with Eastern Char. It is one of six highly sensitive lakes in southwestern B.C. monitored to determine if there were any measurable effects due to acidic inputs from the atmosphere (e.g., rain, snow and dustfall). The lake is acid-sensitive because it has a small watershed and the land and water have a relatively low capacity to absorb acids.

What are the main human influences on water quality?

Inputs of acids and other contaminants from the atmosphere are the main influences.

What water quality indicators were monitored?

Lake water was analysed once every month during 1984-93 for major ions, trace metals, nutrients, pH, alkalinity, hardness, dissolved and suspended solids, and colour. Phytoplankton and zooplankton (tiny aquatic plants and animals) were sampled once per month from May to October during 1984-92 to determine the numbers and kinds present. The large plants in the lake were surveyed in 1984 and 1989.

What are the water quality trends and what caused them?

There was a declining trend in total phosphorus from 1984 to 1993. We don't know the cause of this trend, but similar declining trends in phosphorus were observed in half of the small lakes monitored in southwestern B.C.

What is the environmental significance of the trend?

The declining levels of phosphorus in the lake should minimize algal growth and make the lake more aesthetically appealing for recreation. However, if phosphorus levels become too low, the lake could become biologically unproductive.

Are there any other water quality concerns?

No. The water quality of Spectacle Lake was not evaluated in the 1996 B.C. Water Quality Status Report.

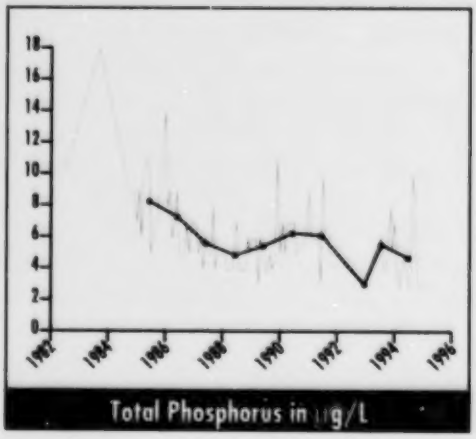
What is being one?

Monitoring was suspended in 1993 because no water quality concerns were evident. A 10-year baseline of data has been collected, which can be used to check for changes in the future if there are concerns about acidification. The phenomenon of declining lake phosphorus is being investigated.

Old Wolf Lake

What are the water quality trends?
There was an improving trend in total phosphorus due to unknown factors.

Improving trend



What are the main attributes of Old Wolf Lake?

Old Wolf Lake is a small lake with a surface area of 0.24 km^2, draining 1.75 km^2 of the Sooke River watershed on Vancouver Island west from Victoria. The lake is in the Capital Regional District's water supply area, and access is controlled to limit human use, but it is not used for water supply. The lake was stocked with rainbow trout in 1984. It is one of six highly sensitive lakes in southwestern B.C. monitored to determine if there were any measurable effects due to acidic inputs from the atmosphere (e.g., rain, snow and dustfall). The lake is acid-sensitive because it has a small watershed and the land and water have a relatively low capacity to absorb acids.

What are the main human influences on water quality?

These include inputs of acids and other contaminants from the atmosphere. The watershed was covered with second-growth forest until 1986, when 11% of the watershed along the eastern shore of the lake was clear-cut. A further 1% of the watershed was cleared in 1988.

What water quality indicators were monitored?

Lake water was analysed once every month during 1984-95 for major ions, trace metals, nutrients, pH, alkalinity, hardness, dissolved and suspended solids, and colour. Phytoplankton and zooplankton (tiny aquatic plants and animals) were sampled once per month from May to October during 1984–94 to determine the numbers and kinds present. The large plants in the lake were surveyed in 1984 and 1989.

What are the water quality trends and what caused them?

There was a declining trend for total phosphorus from 1985 to 1995. We don't know the cause of this trend, but similar declining trends in phosphorus were observed in half of the small lakes monitored in southwestern B.C.

What is the environmental significance of the trend?

The declining levels of phosphorus in the lake should minimize algal growth and make the lake more aesthetically appealing for recreation. However, if phosphorus levels become too low, the lake could become biologically unproductive.

Are there any other water quality concerns?

No. The water quality of Old Wolf Lake was not evaluated in the 1996 B.C. Water Quality Status Report.

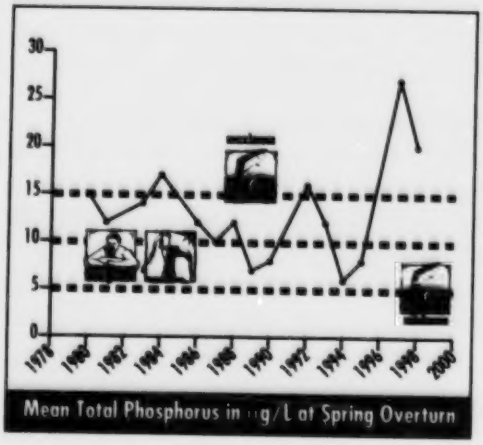
What is being done?

Monthly monitoring was suspended in 1995 because no water quality concerns were evident. A 10-year baseline of data has been collected, which can be used to check for changes in the future if there are concerns about acidification. Annual monitoring at spring overturn is being done to track phosphorus trends, and the phenomenon of declining lake phosphorus is being investigated.

Prospect Lake

What are the water quality trends?
There were no environmentally significant changes. Phosphorus and fecal coliform levels were high at times and should be reduced to improve water quality.

No changes



Mean Total Phosphorus in µg/L at Spring Overturn

What are the main attributes of Prospect Lake?
Prospect Lake is a small lake with a surface area of 0.72 km^2, draining 23 km^2 of the southeast coast of Vancouver Island in the Municipality of Saanich. The lake is used for drinking water, irrigation, recreation, and supports aquatic life and wildlife.

What are the main influences on water quality?
These included non-point sources of contaminants from residential development, including land clearing, road building, and septic tank tile-field effluents. The waterfowl population of the lake is also a source of fecal contamination.

What water quality indicators were monitored?
Lake water has been sampled for nutrients once per year for most years since 1980 during spring overturn when the lake water was well mixed. Other indicators such as turbidity, major ions, metals, carbon, chlorophyll a, colour, conductivity, pH, and dissolved oxygen were measured less regularly. Fecal coliform levels at beaches were monitored by the Capital Health Region during the spring and summer swimming seasons for most years from 1983 to the present.

What are the water quality trends and what caused them?
There was a declining trend in total phosphorus up to 1995, but increased levels in 1996–98 resulted in no significant change over the 1980–98 period.

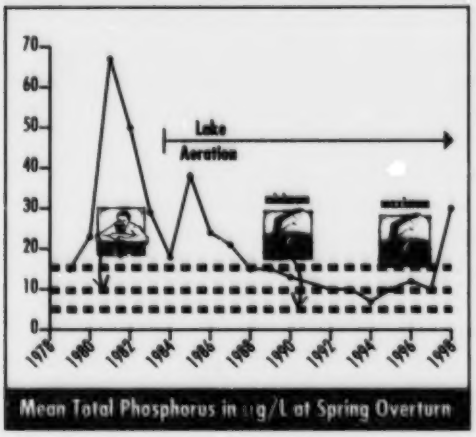
Are there other water quality concerns?
Prospect Lake had relatively high phosphorus levels, exceeding the drinking water and recreation guidelines in most years and the aquatic life guideline in some years. A reduction in phosphorus is desirable to improve drinking water, recreation and aquatic life habitat. The fecal coliform levels at the North Lakeside Beach Park made the water unsuitable for swimming on several occasions between 1983 and 1995. The probable source of the high fecal coliform levels at the beach are the resident waterfowl. Prospect Lake water quality was not evaluated in the 1996 B.C. Water Quality Status Report.

What is being done?
A Prospect Lake stewardship group has been formed, and has been monitoring nutrients and fecal coliforms. They also provide input to the Prospect Lake/Tod Creek Watershed Action Plan being prepared by the Municipality of Saanich. Monitoring is continuing at spring overturn to track the trends in nutrients in the lake, and for fecal contamination at the beaches in summer.

Langford Lake

What are the water quality trends?
Langford Lake had an improving trend in phosphorus due in part to lake aeration and in part to unknown factors. Further phosphorus reduction is desirable.

Improving trend



Mean Total Phosphorus in µg/L at Spring Overturn

What are the main attributes of Langford Lake?
Langford Lake is a small lake with a surface area of 0.6 km^2, draining 3.3 km^2 of the Municipality of Langford west from Victoria. The lake is used for recreation and supports a sports fishery.

What are the main influences on water quality?
These include non-point sources of contaminants from residential runoff, septic tank tile-field effluents, and agriculture. The sediments on the bottom of the lake are a major source of phosphorus for algae in the lake. An aerator was installed in 1984 to try to prevent phosphorus release from the lake sediments and to increase deep water fish habitat.

What water quality indicators were monitored?
Lake water has been sampled once per year for most years since 1979 during spring overturn when the lake water was well mixed. Nutrients, temperature, and dissolved oxygen were measured. Other indicators such as pH, calcium, magnesium, hardness, conductivity, colour, silica, carbon, chlorophyll a, and metals were measured less regularly. Fecal coliform levels at beaches were monitored by the Capital Health Region during the spring and summer swimming seasons for most years from 1980 to the present.

What are the water quality trends and what caused them?
There was a declining trend in phosphorus in the lake from 1981 to 1998, due at least in part to lake aeration after 1984. There were probably other unknown factors since half of the small lakes monitored in southwestern B.C. also had declining phosphorus levels.

What is the environmental significance of the trend?
Less phosphorus in the lake should result in reduced algal blooms, making the water better for recreation and fisheries. Further phosphorus reduction is desirable to improve recreation and fisheries.

Are there any other water quality concerns?
No. The water quality of Langford Lake was not evaluated in the 1996 B.C. Water Quality Status Report.

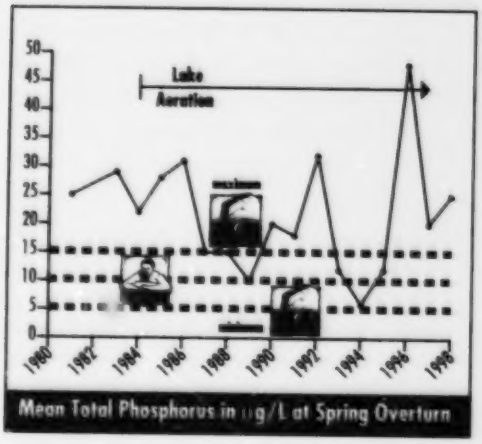
What is being done?
The lake aerator is continuing to operate during the summer to minimize phosphorus release from the lake sediments and to aerate the deep water to enlarge the habitat for fish. More intensive lake monitoring has been recommended and BC Environment is supporting the Langford Lake Area Protection Society to achieve this. Monitoring is continuing at spring overturn to track the trends in nutrients in the lake, and for fecal contamination at the beaches in summer.

Glen Lake

What are the water quality trends?

There were no environmentally significant changes. Phosphorus, dissolved oxygen and fecal contamination levels are in need of improvement.

No changes



Mean Total Phosphorus in ug/L at Spring Overturn

What are the main attributes of Glen Lake?

Glen Lake is a small lake with a surface area of 0.17 km^2, draining 11.9 km^2 of the Municipality of Langford west from Victoria. The lake is used for recreation and supports a sports fishery.

What are the main influences on water quality?

These include non-point sources of contaminants from residential runoff and septic tank-tile field effluents, and agriculture. The sediments on the bottom of the lake are a major source of phosphorus for algae in the lake. An aerator was installed in 1985 to try to prevent phosphorus release from the lake sediments and to increase dissolved oxygen levels and fish habitat. The resident waterfowl are a source of fecal contamination.

What water quality indicators were monitored?

Lake water has been sampled for nutrients once per year since 1981 during spring overturn when the lake water was well mixed. Other indicators such as pH, calcium, magnesium, hardness, conductivity, colour, temperature, turbidity, silicon, sulphate, carbon, metals, dissolved and suspended solids, and dissolved oxygen were measured less regularly. Fecal coliform levels at beaches were monitored by the Capital Health Region during the spring and summer swimming seasons for most years from 1980 to the present.

What are the water quality trends and what caused them?

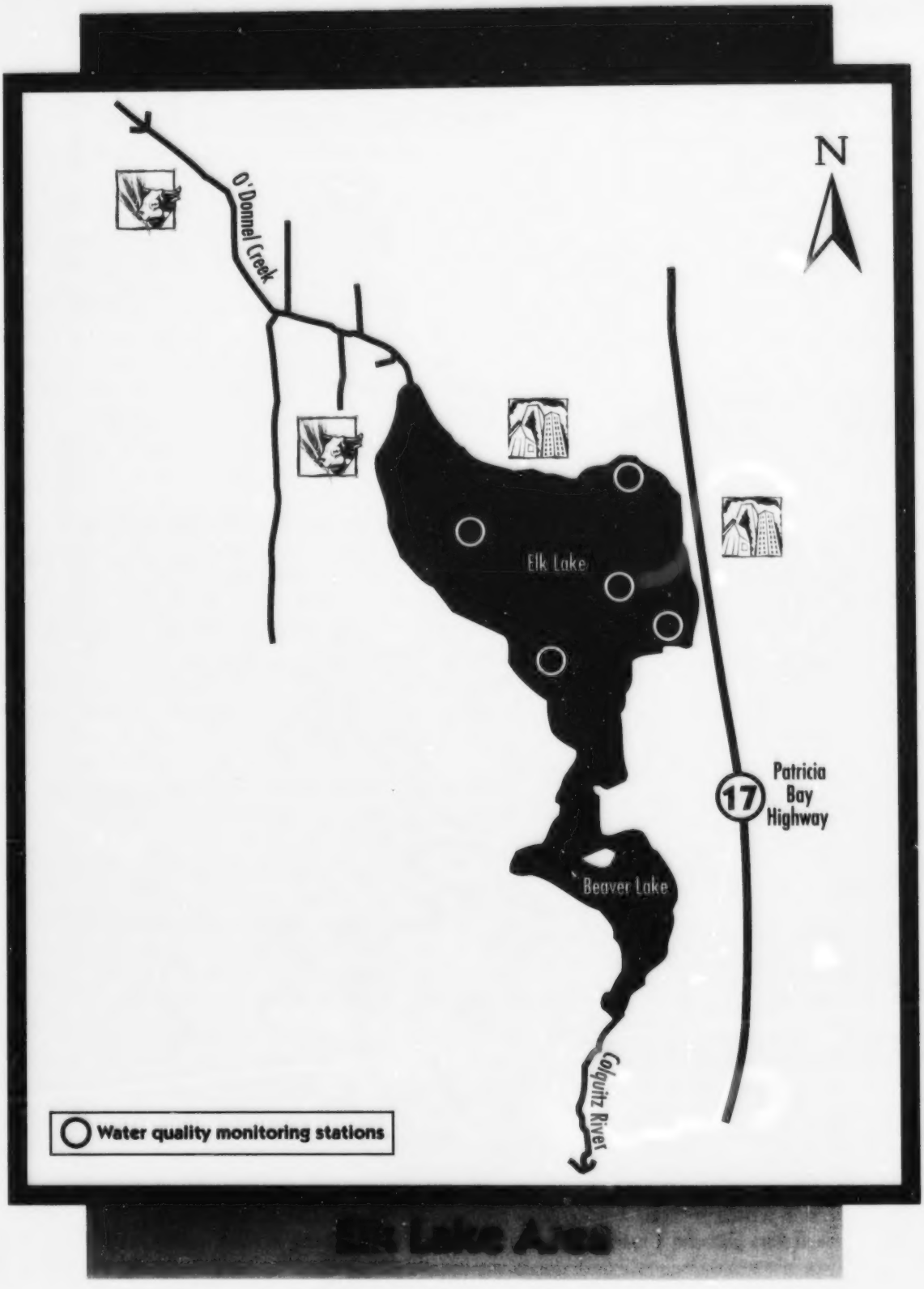
There was a declining trend in total phosphorus up to 1995, but increased levels during 1996–98 resulted in no significant change over the 1981–98 period.

Are there other water quality concerns?

Glen Lake had relatively high phosphorus levels, exceeding the guidelines for recreation and aquatic life in most years. A reduction in phosphorus is desirable for improved recreation and fisheries. Dissolved oxygen levels in the deep lake waters appear to be declining because the aerator has exceeded its useful life and is now inefficient. Fecal contamination due to waterfowl made the water at Glen View beach area unsuitable for swimming on several occasions during 1980-95. The water quality of Glen Lake was not evaluated in the 1996 B.C. Water Quality Status Report.

What is being done?

Fencing is being used to keep waterfowl off Glen View Beach. Further action is needed to set water quality objectives for the lake, to implement more intensive lake monitoring, to develop a remediation plan, and to replace the aerator. A lake stewardship group is needed to lead these actions. Monitoring is continuing at spring overturn to track the trends in nutrients in the lake, and for fecal contamination at the beaches in summer.

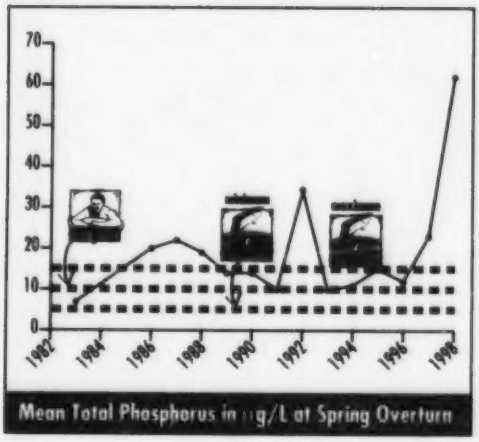


Elk Lake Area

Elk Lake

What are the water quality trends?
There were no statistically significant changes. Phosphorus levels were high in most years and should be reduced to improve water quality.

No changes



Mean Total Phosphorus in µg/L at Spring Overturn

What are the main attributes of Elk Lake?
Elk Lake drains 11.5 km^2 of the southeast coast of Vancouver Island in the Municipality of Saanich, and flows into Beaver Lake via a short, shallow channel. The two lakes have a combined surface area of 2.5 km^2, and are the most popular recreational and fisheries lakes on southern Vancouver Island.

What are the main influences on water quality?
These include non-point sources of contaminants from agriculture, residential development, septic tank-tile field effluents, waterfowl, and the Patricia Bay highway. The sediments on the bottom of the lake are a major source of phosphorus for algae in the lake. The resident waterfowl are a major source of fecal contamination at the beaches.

What water quality indicators were monitored?
Lake water has been sampled once per year since 1983 during spring overturn when the lake water was well mixed. Nutrients and temperature were measured. Other indicators such as major ions, metals, pH, colour, conductivity, chlorophyll a, extinction depth, dissolved oxygen, and the algal community were measured less regularly. Fecal coliform levels at beaches were monitored by the Capital Health Region during the spring and summer swimming seasons for most years from 1980 to the present.

What are the water quality trends and what caused them?
There were no statistically significant changes from 1983 to 1998.

Are there any water quality concerns?
Elk Lake had relatively high phosphorus levels, exceeding the guideline for recreation in most years and the guideline for aquatic life in some years. The 1996 B.C. Water Quality Status Report rated the water quality of Elk Lake as borderline, because the water quality objectives for dissolved oxygen and algae were not met in the summer of 1993. The rating slipped to poor using the 1993-95 monitoring results. These ratings reflect the eutrophic nature of the lake caused by too much phosphorus. Further phosphorus reduction in Elk Lake is desirable for improved recreation and fisheries.

What needs to be done?
There is a need to create a stewardship group to develop a watershed management plan. This includes a remediation plan and a monitoring program to track improvements in water quality and the attainment of water quality objectives as remediation is implemented. Monitoring is continuing at spring overturn to track the trends in nutrients in the lake, and for fecal contamination at the beaches in summer.

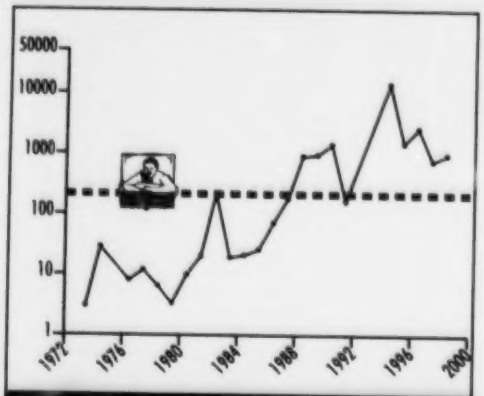
N
MAPLE BAY
MAPLE BAY
Watershed Boundary
Elkington Creek
MacIntyre Creek
Quamichan Lake
Art Mann Park
Somenos Lake
Somenos Creek
DUNCAN
Cowichan River
Water quality monitoring stations

Quamichan Lake

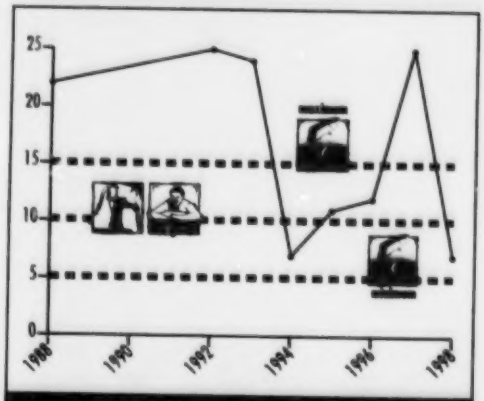
What are the water quality trends?

Quamichan Lake had a deteriorating trend in fecal coliforms due to a growing waterfowl population. Phosphorus levels were high and should be reduced to improve water quality.

Deteriorating trend



Geometric Mean of Fecal Coliforms per 100 mL



Mean Total Phosphorus in µg/L at Spring Overturn

What are the main attributes of Quamichan Lake?

Quamichan Lake has a surface area of 3.1 km^2, and drains 16.3 km^2 of the southeast coast of Vancouver Island near Duncan. The lake is used for recreation and irrigation, and supports a sports fishery and a healthy population of waterfowl. There are 24 domestic water licences on the lake, but the lake is no longer used for drinking water.

What are the main influences on water quality?

These include non-point sources of contaminants from agriculture and residential development, including land clearing, road building, and septic tank-tile field effluents. The waterfowl population is also a significant source of fecal contamination of the lake.

What water quality indicators were monitored?

Lake water has been sampled once per year for most years since 1988 during spring overturn when the lake water was well mixed. Nutrients, pH, major ions, metals, conductivity, colour, and temperature were measured. Fecal coliforms were measured by the Central Vancouver Island Health Unit at the Art Mann Park beach once per week for one to three months during the summer swimming season for most years since 1973.

What are the water quality trends and what caused them?

There was an increasing trend in fecal coliforms during the 1980's and 90's, probably due to increasing waterfowl populations on the lake.

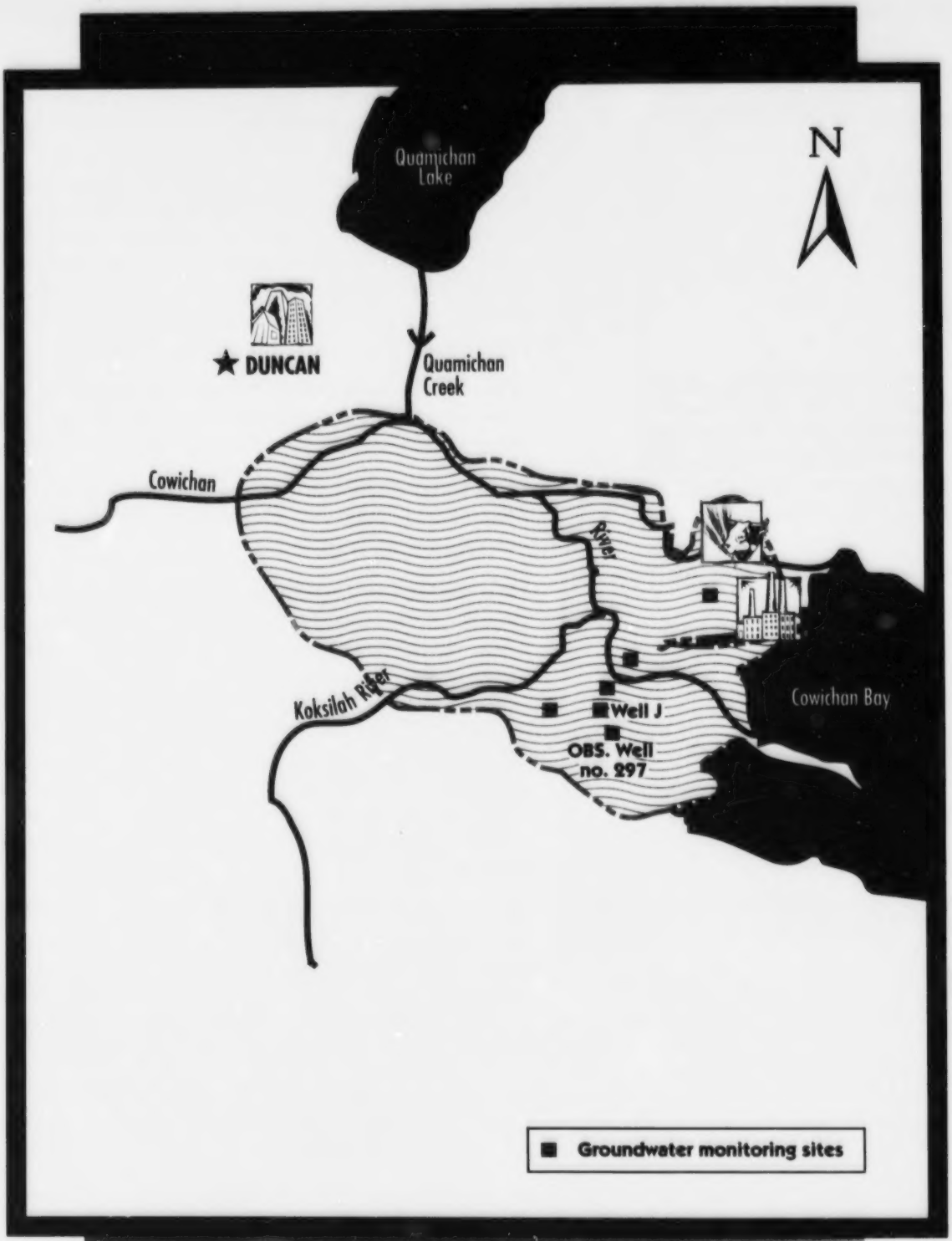
What is the environmental significance of the trend?

The increasing trend in fecal coliforms caused the beach at Art Mann Park to be unsuitable for swimming.

Are there any other water quality concerns?

Quamichan Lake had relatively high levels of phosphorus at spring overturn, exceeding the guidelines for drinking water, recreation and aquatic life in most years. Phosphorus reduction is desirable to improve drinking water, recreation and habitat for aquatic life. The water quality of Quamichan Lake was not evaluated in the 1996 B.C. Water Quality Status Report.

What needs to be done? Continued and expanded monitoring is needed to determine the present state of water quality in the lake, and to identify and evaluate remediation options to improve water quality in the lake for recreation and fisheries. Waterfowl management techniques should be considered. A local stewardship group is needed to lead the monitoring and remediation plan. Limited monitoring is continuing at spring overturn to track long-term nutrient trends and in summer to track fecal contamination at the beach.



Cowichan Estuary Lower Aquifer

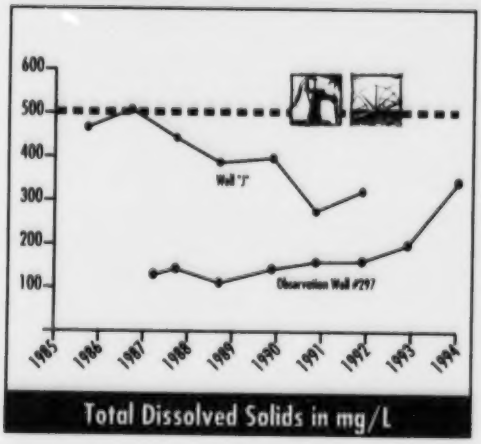
Cowichan Estuary Lower Aquifer

What are the water quality trends?
The salt levels in five of six wells in the Cowichan Estuary Lower Aquifer showed no changes or improving trends. One well showed a deteriorating trend.

Improving Trends – 1 well

No Changes – 4 wells

Deteriorating Trends – 1 well



Total Dissolved Solids in mg/L

What are the main attributes of the Cowichan Estuary Lower Aquifer? The aquifer is located at the mouth of the Cowichan River southeast from Duncan and is comprised of sand and gravel and is highly productive. The aquifer is the deepest of three aquifers in the estuary and is not vulnerable to contamination from the land surface. However, there is a concern about seawater encroachment into the aquifer caused by large capacity pumping wells at the estuary. The aquifer provides water for local residents and a community waterworks, as well as industries in the estuary.

What are the main human influences on water quality?
Influences on water quality include salt water encroachment caused by pumping more water from the aquifer at the estuary than is recharged.

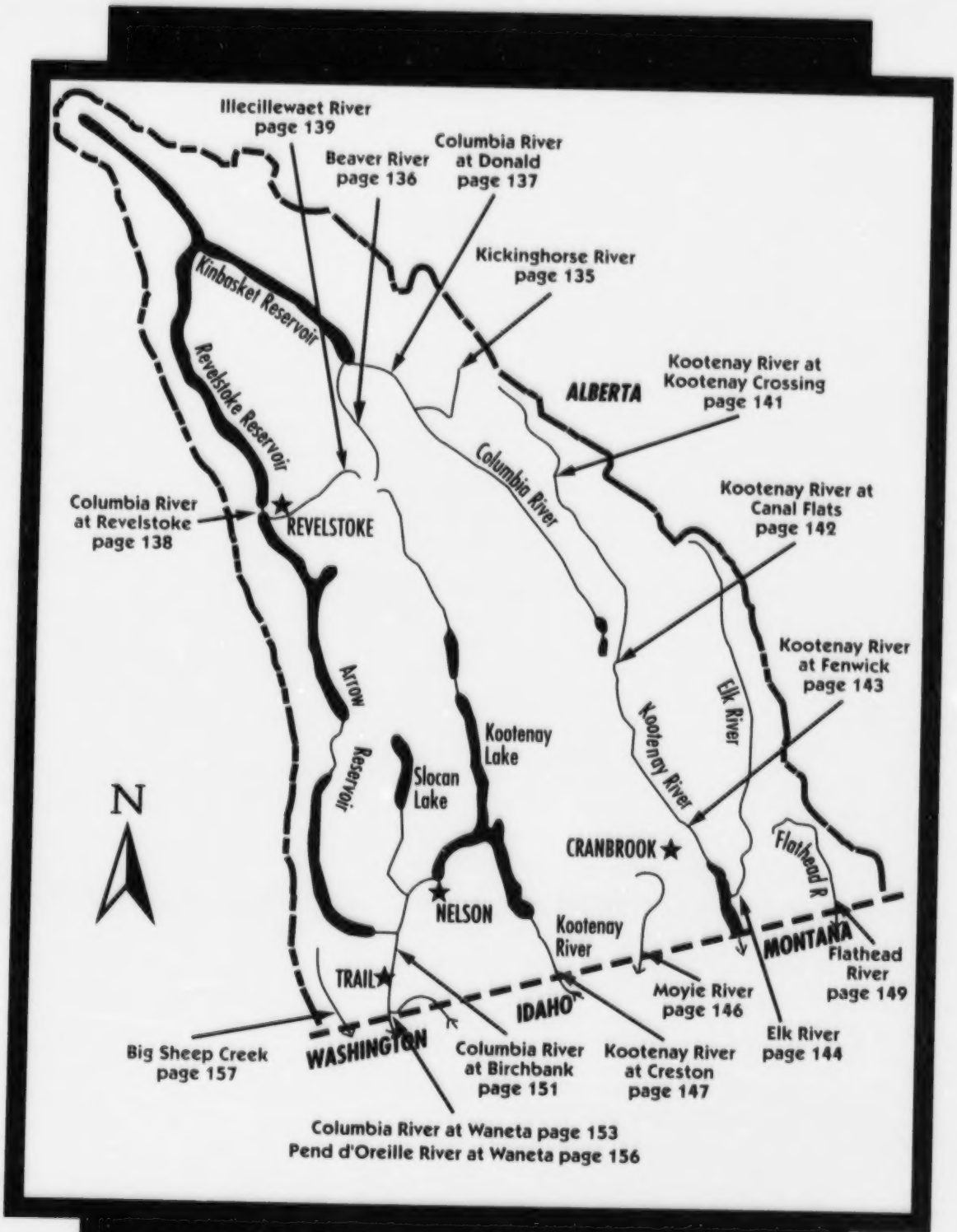
What water quality indicators were monitored?
Dissolved solids, major ions, trace elements, and temperature were monitored annually in the autumn, from 1985 to 1994.

What are the water quality trends and what caused them?
There are six wells with enough long-term data to assess water quality trends. For chloride and total dissolved solids (TDS), four wells showed no changes, one well showed an improving trend (decreasing values), and one well showed a deteriorating trend. The graph shows the improving trend and the deteriorating trend for TDS at two adjacent wells. Current ground-water use in the estuary does not appear to be causing significant saltwater encroachment into the aquifer. It is important to note that each well provides information on water quality at a specific point in the aquifer, and is not representative of the entire aquifer.

What is the environmental significance of the trends?
The TDS levels in the well showing a deteriorating trend were below the drinking water and irrigation guidelines, but the levels would exceed the guidelines within five years if the trend persists at the same rate. The well showing an improving trend had a value exceeding the guidelines in 1987, but TDS has declined steadily since then.

Are there any other water quality concerns?
No. The water quality of this aquifer was not evaluated in the 1996 B.C. Water Quality Status Report.

What will be done to maintain water quality?
The Ministry discontinued monitoring groundwater quality in the estuary in 1994, but will begin monitoring again at one or two critical stations. A report on the monitoring between 1985 and 1994 will be published by the Ministry to inform local water users and stewardship groups about the groundwater quality in the Cowichan Estuary Lower Aquifer.



Kootenay Region

KOOTENAY REGION SUMMARY

The Kootenay Region is located in the southeastern part of the Province, bordering the province of Alberta and the states of Washington, Idaho and Montana. It is located entirely within the Columbia River basin, draining portions of the Rocky, Purcell, Selkirk and Monashee mountains. The main BC Environment regional offices are located in Nelson and Cranbrook.

There have been 16 long-term water quality monitoring stations in this Region. Ten of these stations had no environmentally significant changes in water quality. Three stations had deteriorating trends in water quality, while three stations had improving trends. The water quality trends in these waterbodies are summarized in the table below.

If you have any questions on the trend reports or want more information on other waterbodies in the Region, please contact:

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Deteriorating Trends in Water Quality

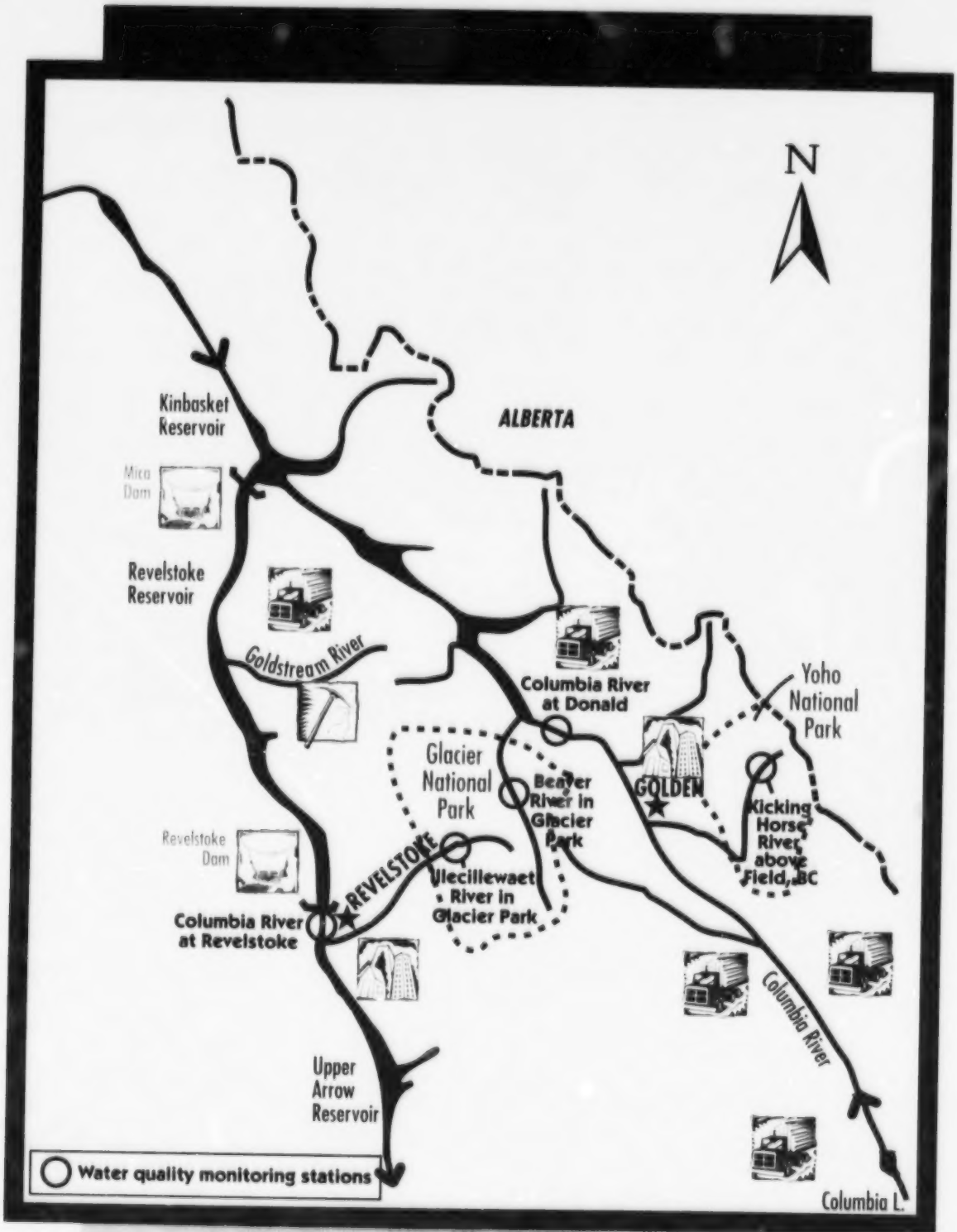
Location (Years)	Water Quality Indicators	Cause of Trend	Water Uses at Risk	Action
Elk River (1984–97)	Selenium Nitrogen	Coal mining Coal mining	Aquatic life Recreation	Studies are underway and monitoring is continuing.
Kootenay River at Creston (1979–97)	Phosphorus	Dam/reservoir	Aquatic life (declining Kootenay Lake fish production)	Fertilization of Kootenay Lake since 1992. Monitoring is continuing.
Columbia River at Revelstoke (1984–97)	Phosphorus	Dams/reservoirs	Aquatic life (limits fish production)	Studies have been done and fertilization of Upper Arrow Reservoir began in 1999.

Improving Trends in Water Quality

Location (Years)	Water Quality Indicators	Cause of Trend	Water Uses at Risk	Action
Kootenay River at Fenwick Station (1991–96)	Zinc	Waste abatement	Aquatic life	Continued waste abatement and monitoring.
Columbia River at Birchbank (1983–97)	Iron, Aluminum	Dams/reservoirs	Drinking water, aquatic life	Abatement for total dissolved gases is being planned. Monitoring is continuing.
Columbia River at Waneta (1983–96)	Cadmium, Chromium Iron, Lead, Zinc, Fluoride, Sulphate, Phosphorus	Waste abatement	Aquatic life, drinking water, irrigation, recreation	Continued abatement for cadmium, chromium, copper, zinc, and total dissolved gases. Monitoring is continuing.

No Changes in Water Quality – Other Water Quality Concerns

Location (Years)	Water Quality Indicators	Concern	Water Uses at Risk	Action
Kickinghorse River above Field (1987–95)		None		Monitoring is continuing.
Beaver River in Glacier National Park (1987–95)		None		Monitoring is continuing.
Columbia River at Donald (1984–95)		None		None needed.
Illecillewaet River in Glacier National Park (1987–95)		None		Monitoring is continuing.
Kootenay River at Kootenay Crossing (1987–95)		None		Monitoring is continuing.
Kootenay River at Canal Flats (1985–95)		None		Monitoring is continuing.
Moyie River at Kingsgate (1979–95)		None		None needed.
Flathead River at US Border (1979–95)		None		None needed.
Pend D'Oreille River at Waneta (1980–95)	Total dissolved gases	Dams have caused levels that are harmful to fish.	Aquatic life	Means of reducing total dissolved gases are being investigated. Monitoring is continuing.
Big Sheep Creek near US Border (1979–95)		None		None needed.



Upper Columbia River Area

Kickinghorse River Above Field, BC

What are the water quality trends?
There were no environmentally significant changes.

No changes

What are the main attributes of the Kickinghorse River?

The Kickinghorse River above Field drains 344 km^2 of the Rocky Mountains in the headwaters of the Columbia River basin. This is a relatively pristine watershed completely within Yoho National Park and has high recreational values. The Kickinghorse River has been designated as a Heritage River by the Canadian Heritage Rivers Board due to its outstanding natural and historical features.

What are the main human influences on water quality?

The Trans-Canada highway, the Canadian National Railway mainline, recreational activities in the national park, and atmospheric deposition of contaminants carried by rain and snow are the main potential human influences on water quality.

What water quality indicators were monitored?

Major ions, trace elements, nutrients, colour, dissolved and suspended solids, pH, and temperature have been monitored once every two weeks since 1987. Flow has been monitored continuously.

What are the water quality trends and what caused them?

There were no environmentally significant changes from 1987 to 1995.

Are there any other water quality concerns?

No. The water quality of the Kickinghorse River was not evaluated in the 1996 B.C. Water Quality Status Report.

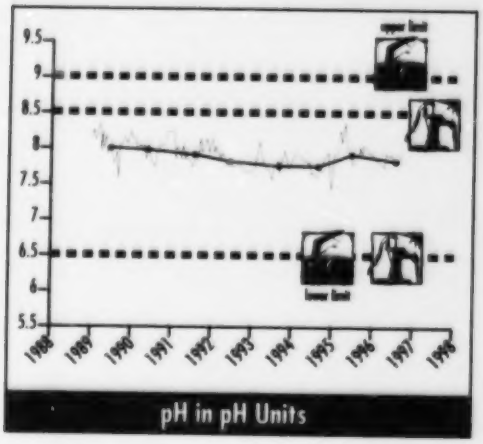
What will be done to maintain water quality?

There are no apparent water quality concerns or changes at this time. Monitoring is continuing to help ensure that the integrity of the river is preserved, and to detect any changes in water quality in Yoho National Park.

Beaver River in Glacier National Park

What are the water quality trends?
There were no environmentally significant changes, although a slight declining trend in pH was observed.

No changes



pH in pH Units

What are the main attributes of the Beaver River?
The Beaver River in Glacier National Park drains 472 km^2 of the Purcell Mountains in the headwaters of the Columbia River basin. This is a relatively pristine watershed with high recreational values that lies completely within Glacier National Park.

What are the main human influences on water quality?
The Trans-Canada highway, the Canadian National Railway mainline, recreational activities in the national park, and atmospheric deposition of contaminants carried by rain and snow are the main potential human influences on water quality.

What water quality indicators were monitored?
Major ions, trace elements, nutrients, colour, dissolved and suspended solids, pH, and temperature were monitored once every two weeks since 1987. Flow has been monitored continuously downstream near the mouth of the river where the drainage area is 1150 km^2.

What are the water quality trends and what caused them?
There were no environmentally significant changes from 1987 to 1995. A slight declining trend in pH was observed as shown in the graph. The cause of this apparent decline is not known and it may be nothing more than natural variation.

What is the environmental significance of the trend?
The slight declining trend in pH would have to persist at it's present rate for about 50 years before pH reached the lower guidelines for drinking water and aquatic life and it became environmentally significant.

Are there any other water quality concerns?
No. The water quality of the Beaver River was not evaluated in the 1996 B.C. Water Quality Status Report.

What will be done to maintain water quality?
Monitoring is continuing to see if the declining pH trend persists and to detect any other changes in water quality in Glacier National Park.

Columbia River at Donald

What are the water quality trends?
There were no environmentally significant changes.

No changes

What are the main attributes of the Columbia River at Donald?
The Columbia River at Donald flows in the Rocky Mountain Trench, draining 9,710 km^2 of the headwaters of the Columbia River, with the Rocky Mountains to the east and the Purcell Mountains to the west. Columbia and Windermere lakes lie at the upper end of the watershed, followed by the Columbia River Flats, whose marshes are important waterfowl habitat. Cirque glaciers in the high Purcells and Rockies drain to the Columbia River and the glacial silt imparts a gray, muddy colour to the river at times. The river is used for drinking water, irrigation and industry and supports a population of cutthroat, rainbow, bull, and eastern brook trout and whitefish. The Columbia River was declared a B.C. Heritage River in 1998.

What are the main human influences on water quality?
Timber harvesting, the Town of Golden, Radium Hot Springs, highways, and railways are the main potential human influences on water quality.

What water quality indicators were monitored?
Major ions, trace elements, nutrients, colour, dissolved and suspended solids, pH, and temperature were monitored once every two weeks from 1984 to 1995. The station is located just upstream from Kinbasket Lake, the reservoir created by the Mica Dam. Flow has been monitored continuously.

What are the water quality trends and what caused them?
There were no environmentally significant changes from 1984 to 1995.

Are there any other water quality concerns?
No. The water quality of the Upper Columbia River was not evaluated in the 1996 B.C. Water Quality Status Report.

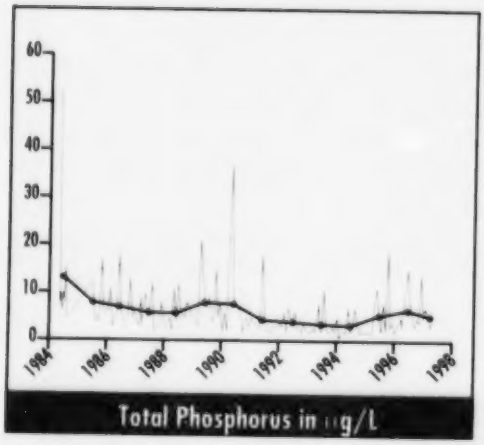
Does anything need to be done?
No. There were no apparent water quality changes or concerns during 1984-95, and monitoring was suspended in 1995.

Columbia River at Revelstoke

What are the water quality trends?

There was a deteriorating trend in phosphorus due to upstream dams and reservoirs. This is viewed as a deteriorating trend because the Arrow Lakes have a shortage of phosphorus, which has contributed to declining fish production. Fertilization of Upper Arrow Lake with phosphorus began in 1999 to boost fish production.

Deteriorating trend



Total Phosphorus in µg/L

What are the main attributes of the Columbia River at Revelstoke? The Columbia River at Revelstoke drains the upper 26,700 km^2 of the Columbia River basin. The upper Columbia River is dominated by hydroelectric development. The Mica Dam and its massive reservoir, Kinbasket Lake, are located 130 km upstream and the Revelstoke Dam and Lake Revelstoke lie just 6 km upstream from Revelstoke. Just downstream lie the Arrow Lakes, which serve as a reservoir for the Hugh Keenleyside Dam at Castlegar. The Columbia River near Revelstoke is also used for irrigation, livestock watering, drinking water and recreation, and supports significant fish and wildlife populations. The Columbia River was declared a B.C. Heritage River in 1998.

What are the main human influences on water quality? The hydroelectric dams and reservoirs at Mica (1976) and Revelstoke (1983), timber harvesting, and a closed copper/zinc mine on the Goldstream River, which flows into the Revelstoke reservoir, are the main potential influences on water quality.

What water quality indicators were monitored? Major ions, trace elements, nutrients, colour, dissolved and suspended solids, pH, and temperature were monitored once every four weeks from 1985 to 1997.

What are the water quality trends and what caused them? The upstream dams and reservoirs have altered the flow and water quality patterns in the river, and a declining trend in total phosphorus was detected. The decline was probably due to the trapping effect of upstream dams and reservoirs.

What is the environmental significance of the trend? Declining phosphorus in the Columbia River reduced lake productivity and fish production in the Arrow Lakes.

Are there any other water quality concerns? Yes. Upstream dams may have caused high levels of total dissolved gases in the Columbia River at Revelstoke at times, but few measurements have been made. The water quality of the Upper Columbia River was not evaluated in the 1996 B.C. Water Quality Status Report.

What is being done? The Columbia Basin Fish & Wildlife Compensation Program, a BC Environment and BC Hydro joint venture, in partnership with the Ministry of Transportation & Highways, Revelstoke Marine Branch, the Columbia Power Corporation, and the Columbia Basin Trust, began fertilizing Upper Arrow Lake in April 1999 to improve fish production. This is an ongoing project and they are monitoring to evaluate the effect of fertilization on fish production. Similar fertilization in Kootenay Lake has been highly successful. The Upper Columbia River International Task Force is investigating means to reduce total dissolved gases throughout the Columbia River basin in Canada and the U.S. Water use planning is being conducted with B.C. Hydro for all dams in the Columbia basin to address total dissolved gas concerns.

Illecillewaet River in Glacier National Park

What are the water quality trends?
There were no environmentally significant changes.

No changes

What are the main attributes of the Illecillewaet River?
The watershed above the Illecillewaet River water quality station has a drainage area of 203 km^2 in the Purcell Mountains and lies completely within Glacier National Park. This is a relatively pristine watershed with high recreational values. The Illecillewaet River flows into the Upper Arrow Reservoir on the Columbia River near Revelstoke after draining about 1,200 km^2 of the Purcell Mountains.

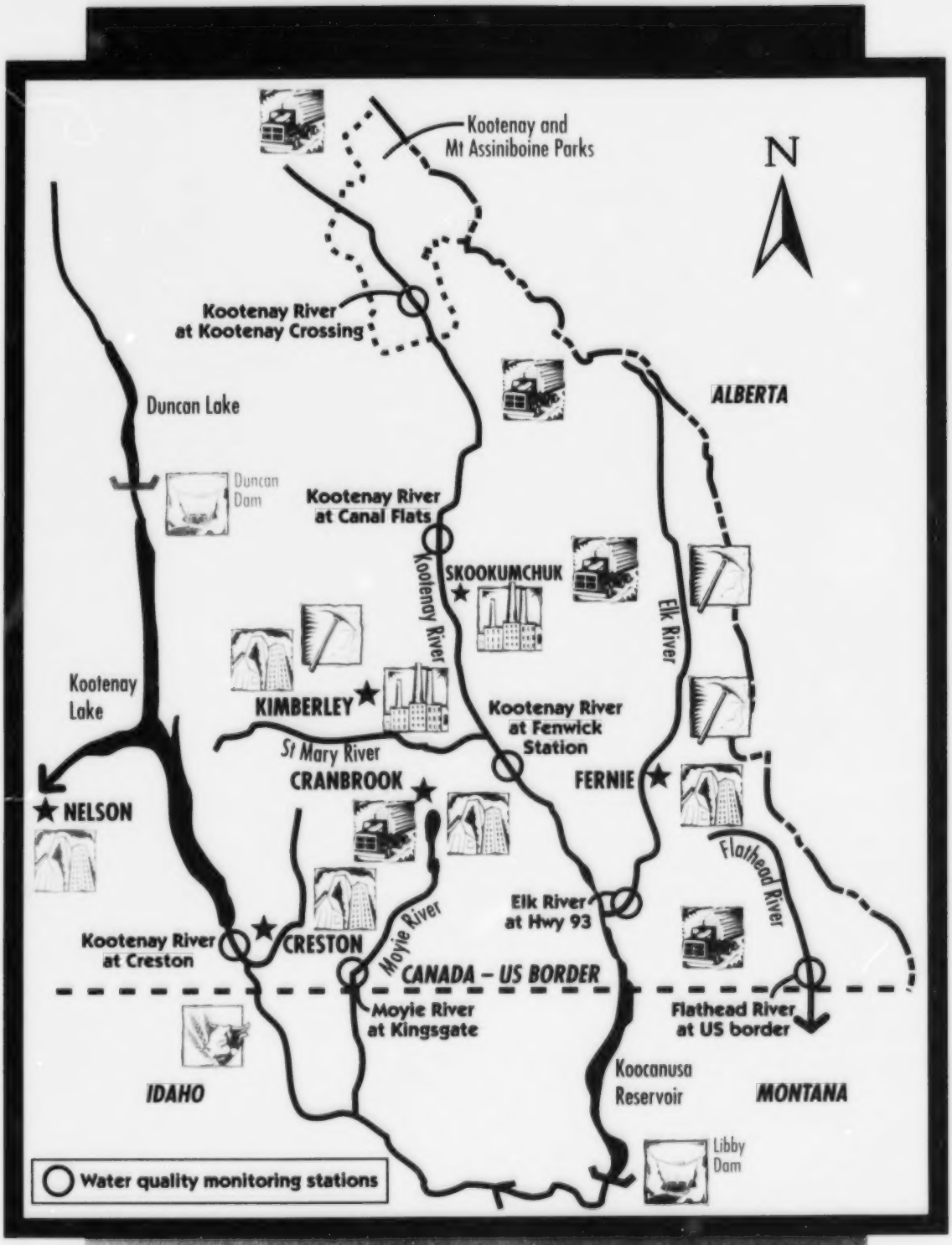
What are the main human influences on water quality?
The TransCanada highway, the Canadian National Railway mainline, recreational activities in the national park, and contaminants deposited with rain and snow are the main potential human influences on water quality.

What water quality indicators were monitored?
Major ions, trace elements, nutrients, colour, dissolved and suspended solids, pH, and temperature were monitored once every two weeks since 1987. Flow has been monitored continuously about 30 km downstream from the water quality station, where the drainage area is 1,170 km^2.

What are the water quality trends and what caused them?
There were no environmentally significant changes from 1987 to 1995.

Are there any other water quality concerns?
No. The water quality of the Illecillewaet River was not evaluated in the 1996 B.C. Water Quality Status Report.

What will be done to maintain water quality?
There are no apparent water quality concerns or changes at this time. Monitoring is continuing to detect any changes in water quality in Glacier National Park.



Kootenay & Flathead River Area

Kootenay River at Kootenay Crossing

What are the water quality trends?
There were no environmentally significant changes.

No changes

What are the main attributes of the Kootenay River at Kootenay Crossing?
The Kootenay River at Kootenay Crossing drains 420 km^2 of the Rocky Mountains in the headwaters of the Kootenay-Columbia River basin. Most of its watershed lies within Kootenay National Park and Mount Assiniboine Park and has high recreational values.

What are the main human influences on water quality?
Highway 93, recreational activities in the parks, contaminants deposited with rain and snow, and timber harvesting in the northern part of the basin are the main potential human influences on water quality.

What water quality indicators were monitored?
Major ions , trace elements, nutrients, colour, dissolved and suspended solids, pH, and temperature were monitored once every two weeks since 1987. Flow has been monitored continuously.

What are the water quality trends and what caused them?
There were no environmentally significant changes from 1987 to 1995.

Are there any other water quality concerns?
No. The water quality of the Kootenay River was not evaluated in the 1996 B.C. Water Quality Status Report.

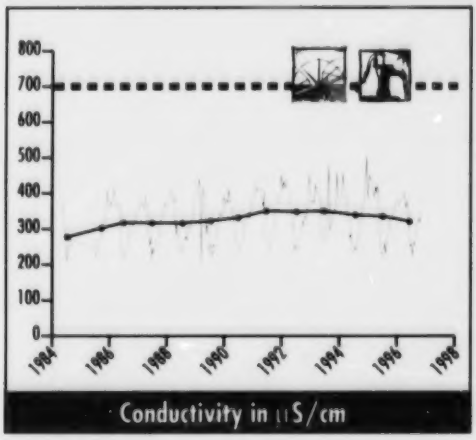
What will be done to maintain water quality?
There were no apparent water quality concerns or changes from 1987 to 1995. Monitoring is continuing to detect any changes in water quality in Kootenay National Park, as well as to serve as a relatively pristine control station for the Kootenay watershed.

Kootenay River at Canal Flats

What are the water quality trends?

There were no environmentally significant changes, although a slight increasing trend in conductivity, a measure of dissolved ions, was observed.

No changes



Conductivity in µS/cm

What are the main attributes of the Kootenay River at Canal Flats?

The Kootenay River at Canal Flats drains 5,390 km^2 of the Rocky Mountains, with much of the northern half of the basin in Kootenay National Park and Mount Assiniboine Park. The upper Kootenay River has good potential for streamside camping, fishing and viewing wildlife.

What are the main human influences on water quality?

Most of the southern half of the basin has been used for timber harvesting.

What water quality indicators were monitored?

Major ions, trace elements, nutrients, colour, dissolved and suspended solids, pH, and temperature were monitored once every two weeks from 1985 to 1995. Flow has been monitored continuously.

What are the water quality trends and what caused them?

There were no environmentally significant changes over the decade from 1985-95. A slight increasing trend in conductivity, a measure of the dissolved ions in water, was detected, but the cause is unknown. This trend might be due to timber harvesting or may be nothing more than natural variation. In any case, the levels have begun to decline since 1995.

What is the environmental significance of the trend?

There were no environmentally significant changes, and the increasing trend in conductivity would have to persist at its present rate for about 50 years before it would reach the guidelines for drinking water and irrigation and become environmentally significant.

Are there any other water quality concerns?

No. The water quality of the Kootenay River was not evaluated in the 1996 B.C. Water Quality Status Report.

What will be done to maintain water quality?

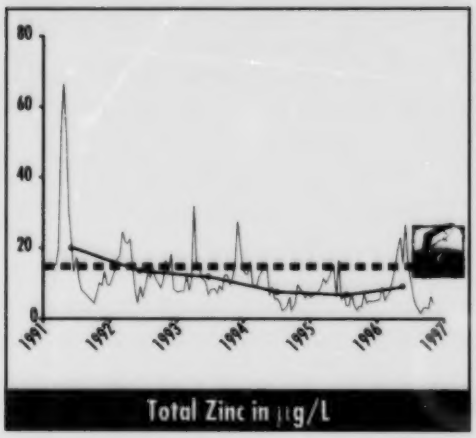
There are no apparent water quality concerns or environmentally significant changes at this time, and monitoring is continuing for a more limited suite of indicators. Conductivity will continue to be tracked to see if the increasing trend persists.

Kootenay River at Fenwick Station

What are the water quality trends?

The Kootenay River at Fenwick Station had an improving trend in zinc due to on-going abatement of acid rock drainage at the Cominco Ltd. Sullivan mine at Kimberley.

Improving trend



Total Zinc in µg/L

What are the main attributes of the Kootenay River at Fenwick Station?

The Kootenay River at Fenwick Station flows in the Rocky Mountain Trench, draining 12,000 km^2 of the Rocky Mountains to the east and the Purcell Mountains to the west. It is a transboundary river, which joins the Elk River in B.C. and flows into Koocanusa Lake. This reach of the Kootenay River supports significant fisheries and is used for irrigation.

What are the main human influences on water quality?

The Cominco Ltd. Sullivan mine, concentrator and former fertilizer complex at Kimberley in the St. Mary River watershed, and the Crestbrook Forest Industry Ltd. kraft pulp mill at Skookumchuck have been the main influences on water quality.

What water quality indicators were monitored?

Major ions, trace elements, nutrients, colour, dissolved and suspended solids, pH, and temperature have been monitored once every two weeks since 1984. Flow has been monitored continuously about 16 km upstream at Fort Steele, where the drainage area is 11, 400 km^2.

What are the water quality trends and what caused them?

The Kootenay River at Fenwick Station had an improving trend in total zinc as shown on the graph. The zinc measurements before 1991 are not reliable due to artificial contamination and were not plotted. Zinc levels have declined since the early 1990's due to the on-going abatement of acid rock drainage at Cominco's Sullivan mine at Kimberley.

What is the environmental significance of the trend?

Zinc levels often exceeded safe levels for aquatic life in the Kootenay River in the early 1990's, but have declined to safe levels for most of the time since 1994.

Are there any other water quality concerns?

No. The water quality of the Kootenay River was not evaluated in the 1996 B.C. Water Quality Status Report.

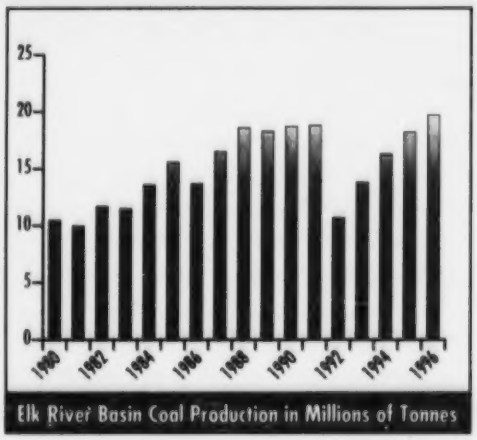
What will be done to further improve water quality?

Acid rock drainage abatement is continuing at Cominco's Sullivan mine to reduce zinc levels in the St. Mary and Kootenay rivers to consistently acceptable levels, as the mine works towards permanent closure by 2002. Monitoring of the Kootenay River at Fenwick Station is continuing and regular monitoring of the St. Mary River has been started.

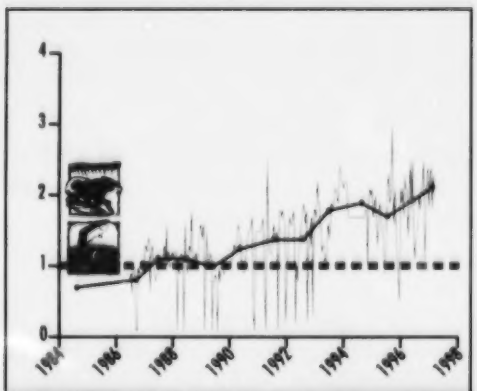
Elk River at Highway 93

What are the water quality trends?
The Elk River had deteriorating trends for selenium and nitrogen. Increasing selenium levels may affect aquatic life and wildlife. BC Environment is investigating this possibility.

Deteriorating trends



Elk River Basin Coal Production in Millions of Tonnes



Total Selenium in µg/L

What are the main attributes of the Elk River?
The Elk River drains 4,450 km^2 of the Rocky Mountains into Koocanusa Lake on the Kootenay River just before it enters Montana. It is the most heavily-fished river in the Kootenays, with large populations of westslope cutthroat trout, bull trout and whitefish.

What are the main human influences on water quality?
There is widespread coal mining in the upper Elk River basin, and the output of coal from the basin doubled during the 1980's as shown on the graph.

What water quality indicators were monitored?
Major ions, trace elements, nutrients, colour, dissolved and suspended solids, pH, and temperature have been monitored once every two weeks since 1984 in the Elk River just upstream from Koocanusa Lake. Flow has been monitored continuously about 6 km upstream.

What are the water quality trends and what caused them?
Selenium and nitrogen levels increased over the decade. The selenium increase appears to have been caused by the increased disturbance of selenium-bearing soils during coal mining. Nitrogen increased due to the increased use of nitrogen-based explosives as coal production expanded.

What is the environmental significance of the trends?
Selenium levels often exceeded the safe level for aquatic life and wildlife in recent years. The current guideline, however, was developed from information for wetlands where selenium readily accumulates in fish and birds, causing reproductive failures. Fast-flowing streams like the Elk River do not appear to be as susceptible to these effects. Levels farther upstream in the basin, below surface coal mines, also occasionally exceeded the safe level for drinking water, but the water is not used for drinking at this time. Nitrogen levels were well below safe levels for drinking water and aquatic life (10 mg/L), but there was an ample supply for algal growth at all times of the year. This would increase the risk of algal blooms if phosphorus, which limits the growth of algae, was to increase.

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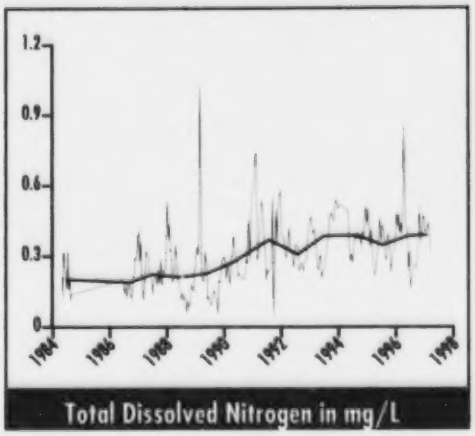
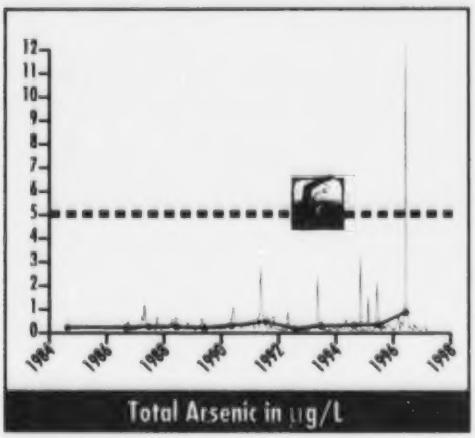


Total Dissolved Nitrogen in mg/L

Are there any other water quality concerns?

There was an apparent increasing trend in peak total arsenic, but it was not statistically significant. The arsenic peaks were correlated with high flows and suspended solids during spring floods. One value exceeded the safe level for aquatic life, but the arsenic was probably bound in suspended solids and thus was likely not available to aquatic life. The water quality of the Elk River was not evaluated in the 1996 B.C. Water Quality Status Report.



Total Arsenic in µg/L

What will be done to improve water quality?

BC Environment and the coal mining companies have investigations underway to determine the sources of selenium and their potential environmental effects. The results of these investigations will help to show the type of corrective action that may be needed to reduce selenium levels. Monitoring of water quality is continuing on the Elk River, including dissolved arsenic and selenium to assess their availability to aquatic life.

Moyie River at Kingsgate

What are the water quality trends?
There were no environmentally significant changes.

No changes

What are the main attributes of the Moyie River?
The Moyie River is a transboundary stream, draining 1,480 km^2 of the Purcell Mountains in southern B.C., crossing the international boundary and entering Idaho at Kingsgate. The Moyie River joins the Kootenai River in Idaho before it re-enters B.C. as the Kootenay River near Creston. The Moyie River is used for fishing, recreation and irrigation. The hardness of Moyie River water was quite low compared to most other East Kootenay rivers, making it more sensitive to metal pollution, should mining ever occur in the basin.

What are the main human influences on water quality?
These include timber harvesting and a little agriculture.

What water quality indicators were monitored?
Major ions, trace elements, nutrients, colour, dissolved and suspended solids, pH, and temperature were monitored about six times per year from 1979 to 1995. Flow has been monitored continuously.

What are the water quality trends and what caused them?
There were no environmentally significant changes from 1979 to 1995.

Are there any other water quality concerns?
No. The water quality of the Moyie River was not evaluated in the 1996 B.C. Water Quality Status Report.

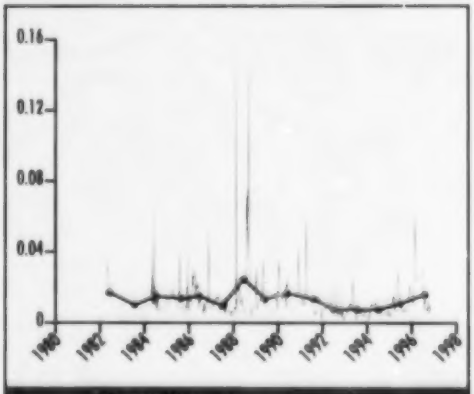
Does anything need to be done?
No. There were no apparent water quality changes or concerns at this time or in the foreseeable future. Monitoring was suspended in 1995.

Kootenay River at Creston

What are the water quality trends?

The Kootenay River at Creston had a declining trend in total phosphorus. This is viewed as a deteriorating trend because Kootenay Lake, downstream from Creston, has a shortage of phosphorus, which has contributed to declining fisheries production. Fertilization of Kootenay Lake with phosphorus began in 1992 to boost fish production, and has been highly successful.

Deteriorating trend



Total Phosphorus in mg/L

What are the main attributes of the Kootenay River at Creston? The Kootenay River is a transboundary stream that flows south from B.C. into Koocanusa Lake, which is the reservoir of the Libby Dam in Montana. After leaving the dam, the river swings northward through Montana and Idaho, re-entering B.C. south from Creston. Just north from Creston, the river enters Kootenay Lake, forming the main inflow to the southern arm of the lake. The Kootenay River near Creston has a drainage area of 36,700 km^2 and is used for irrigation and waterfowl conservation, while Kootenay Lake is an important fishery and recreation area.

What are the main human influences on water quality? The watershed upstream from Creston has been influenced to varying degrees over the years by hydroelectric development at the Libby Dam, a kraft pulp mill at Skookumchuck, a mine, concentrator and fertilizer complex at Kimberley, coal mines in the Elk River basin, treated sewage discharges, agriculture, and forestry.

What water quality indicators were monitored? Major ions, trace elements, nutrients, colour, dissolved and suspended solids, pH, temperature, and fecal coliform bacteria have been monitored once every two weeks since 1979. Flow has been monitored continuously 15 km upstream at the Canada – USA border.

What are the water quality trends and what caused them? Total phosphorus levels have continued to decline during the 1980's and 1990's. This downward trend began in the 1970's with the completion of the Libby Dam in 1972, which trapped phosphorus in the Koocanusa Lake reservoir, and with the reduction in phosphorus discharge from the Cominco fertilizer plant near Kimberley during 1969 to 1979 and with its closure in 1987.

The downward trend during 1982–96 is very subtle, but it is statistically significant. It was most obvious during 1982–94, but increasing levels in 1995–96 have lessened the magnitude of the overall trend.

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What is the environmental significance of the trend?

There are no water quality objectives or guidelines for phosphorus in the Kootenay River, but Kootenay Lake fisheries production has been limited by the lack of phosphorus entering the lake. Phosphorus is needed for growth by algae, which are food for small animals, which, in turn, are eaten by fish. Too much phosphorus causes objectionable algal blooms, but too little phosphorus limits fish production, and a careful balance is needed.

In the 1970's, there was too much phosphorus entering Kootenay Lake and objectionable algal blooms occurred. The reduction of phosphorus from the Cominco fertilizer plant was necessary to improve water quality, but the Libby Dam has further reduced phosphorus below natural levels and Kootenay Lake is now starved for phosphorus.

Are there any other water quality concerns?

Yes. There is concern that the Libby Dam in Montana could cause high levels of total dissolved gases in the Kootenay River near Creston, should it be necessary to spill water at the dam due to a flood or other emergency. The dam has been operated to avoid spilling water, and has not spilled since 1985. The water quality of the Kootenay River was not evaluated in the 1996 B.C. Water Quality Status Report.

What will be done to improve matters?

BC Environment began fertilizing Kootenay Lake with phosphorus in 1992, and it has been continued since 1995 by the Columbia Basin Fish & Wildlife Compensation Program, a joint venture of BC Environment and BC Hydro. Fertilization has resulted in significant increases in kokanee abundance. For example, adult kokanee escapement to the Meadow Creek Spawning Channel and Lardeau River has increased from 270,000 in 1991 to 2.2 million fish in 1998. The Upper Columbia River International Task Force is investigating means to reduce total dissolved gases throughout the Columbia-Kootenay River basin in Canada and the U.S. Monitoring of water quality is continuing at the Kootenay River at Creston, and more monitoring of total dissolved gases will be done in the event of a spill at the Libby Dam.

Flathead River at US Border

What are the water quality trends?
There were no environmentally significant changes.

No changes

What are the main attributes of the Flathead River?
The Flathead River drains 1110 km^2 of the Rocky Mountains in southern B.C. into Montana. The river supports a diversity of fish species, including westslope cutthroat trout, mountain whitefish, bull trout and kokanee.

What are the main human influences on water quality?
These include timber harvesting, coal mine exploration, and road building.

What water quality indicators were monitored?
Major ions, trace elements, nutrients, colour, dissolved and suspended solids, pH, and temperature were monitored weekly or once every two weeks from 1979 to 1995. Flow has been monitored continuously.

What are the water quality trends and what caused them?
There were no environmentally significant changes from 1979 to 1995.

Are there any other water quality concerns?
No. The water quality of the Flathead River was not evaluated in the 1996 B.C. Water Quality Status Report.

Does anything need to be done?
No. There were no apparent water quality changes or concerns from 1979 to 1995. Monitoring was suspended in 1995, but there is a good baseline of data available should concerns arise in the future.

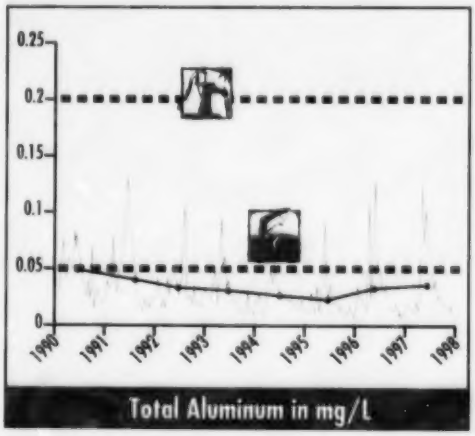
Lower Columbia River Area

Columbia River at Birchbank

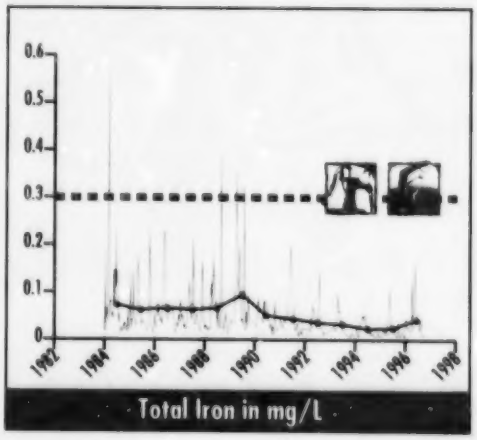
What are the water quality trends?

The Columbia River at Birchbank had improving trends in iron and aluminum. Total gas pressure continued to exceed water quality objectives due to the Keenleyside Dam.

Improving trends



Total Aluminum in mg/L



Total Iron in mg/L

What are the main attributes of the Columbia River at Birchbank?

The Columbia River at Birchbank is downstream from the confluence with the Kootenay River, and drains 88,100 km^2 of the Kootenay-Columbia basin. This reach of the river is used for municipal, industrial and agricultural water supplies, and supports significant fisheries. The Columbia River was declared a B.C. Heritage River in 1998.

What are the main human influences on water quality?

These include the Hugh Keenleyside Dam (1967) upstream from Castlegar, the Libby Dam (1972), the Mica Dam (1976), the Revelstoke Dam (1983), the Celgar pulp mill at Castlegar, and treated sewage discharges from the Nelson-Castlegar area.

What water quality indicators were monitored?

Major ions, trace elements, nutrients, colour, dissolved and suspended solids, pH, temperature, and fecal coliform bacteria have been monitored once every two weeks since 1983. Total phosphorus was also monitored about monthly during 1968–78. Flow has been monitored continuously and total dissolved gas pressure has been monitored periodically.

What are the water quality trends and what caused them?

Iron and aluminum levels declined over the years, but what caused the declines is uncertain. These elements may have been trapped by upstream dams and reservoirs. Total phosphorus records were checked for trends because of concerns that upstream reservoirs and waste abatement may have reduced phosphorus levels.

The graph on the next page shows that phosphorus levels declined during 1968–78. This trend may have been caused by erroneously high values in 1968–70 due to less sensitive measurement methods, but it is also possible that the construction of dams (Keenleyside–1967, Libby–1972, and Mica–1976) and waste abatement at the Cominco fertilizer plant at Kimberley during 1969–79 may have contributed. Nevertheless, phosphorus levels appear to have reached a steady state during 1983–97, because the evidence for a declining trend was weak (less than 95% confidence) and contradictory for this period.

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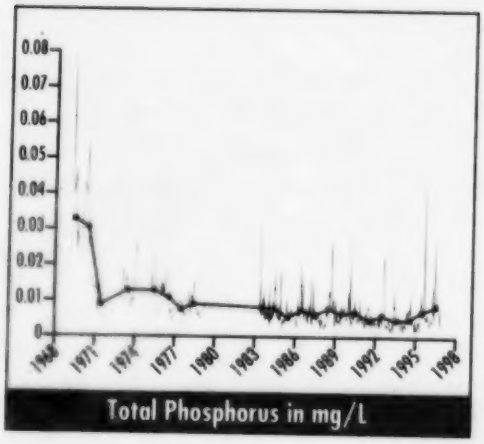
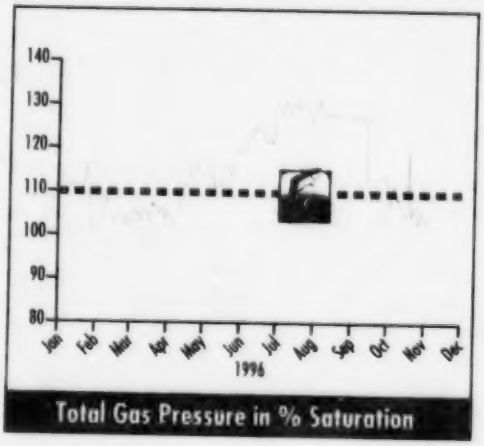


Total Phosphorus in mg/L

What is the environmental significance of the trends?
Lower iron meant that the water was better for drinking water aesthetics and for aquatic life, while lower aluminum may have improved the water for aquatic life.

Are there any other water quality concerns?
The 1996 BC Water Quality Status Report rated the water quality of the Columbia River between Keenleyside and Birchbank as fair, because objectives for organic carbon in sediments, total dissolved gas pressure, and dioxins and furans in sediment and fish were exceeded during 1991-1993. This continued to be the case at Birchbank in 1994-1995. The total dissolved gas pressure levels exceeded safe levels for fish due to air entrainment at the Keenleyside Dam Spillway during 1996 (see graph opposite).



Total Gas Pressure in % Saturation

What will be done to improve water quality? Improvements at the pulp mill have lowered the levels of dioxins and furans in the effluent, and the levels in fish are dropping. The discharge of organic carbon (pulp mill fines) has also been reduced. The installation of a power plant at the Keenleyside Dam is underway and will reduce the dissolved gas levels. Water use planning is being conducted with B.C. Hydro for all dams in the Columbia basin to address total dissolved gas concerns. The Upper Columbia River International Task Force is investigating means to reduce total dissolved gases throughout the Columbia basin in Canada and the U.S. Monitoring is continuing on the Columbia River at Birchbank and total gas pressure monitoring has been started at the Columbia River at Waneta.

Columbia River at Waneta

What are the water quality trends?

The Columbia River at Waneta had improving trends for metals, phosphorus, and major ions due to waste abatement.

Improving trends

What are the main attributes of the Columbia River at Waneta?

The Columbia River at Waneta is just upstream from the confluence with the Pend d'Oreille River and the US border. It drains 88,800 km^2 of the Kootenay-Columbia basin. This reach of the river is used for municipal, industrial and agricultural water supplies, and supports significant fisheries. The Columbia River was declared a B.C. Heritage River in 1998.

What are the main human influences on water quality?

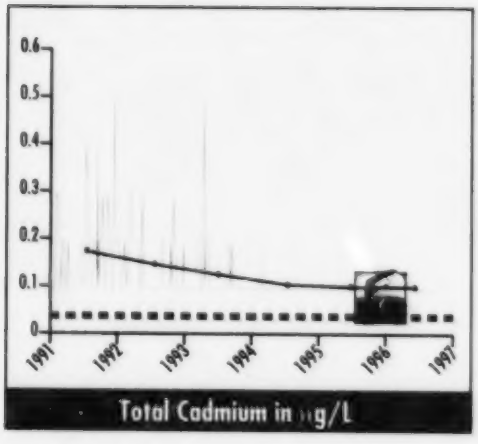
These include the Hugh Keenleyside Dam (1967) upstream from Castlegar, the Libby Dam (1972), the Mica Dam (1976), the Revelstoke Dam (1983), the Celgar pulp mill at Castlegar, treated sewage discharges from the Nelson-Castlegar-Trail area, and the Cominco smelter-fertilizer complex at Trail.

What water quality indicators were monitored?

Major ions, trace elements, nutrients, colour, dissolved and suspended solids, pH, temperature, and fecal coliform bacteria have been monitored weekly since 1983. Flow has been monitored continuously at Birchbank which is 25 km upstream, where the drainage area is 88,100 km^2.

What are the water quality trends and what caused them?

Water quality indicators that declined over time were cadmium, chromium, iron, lead, zinc, fluoride, phosphorus, and sulphate. The plots show the trends for the most important indicators. These declines were due to waste abatement at the Cominco smelter and fertilizer plant, while upstream dams may have contributed to the decline in iron. The fecal coliform record was checked for trends, but the evidence for a declining trend was weak and contradictory.



Total Cadmium in µg/L

What is the environmental significance of the trends?

The declining trends in cadmium, chromium, iron, lead, zinc, fluoride, and sulphate are improving trends, because they made the water safer for aquatic life, drinking water, recreation and irrigation. The aesthetic appeal of the water for drinking was also improved. Further improvement is needed to reduce cadmium, chromium,

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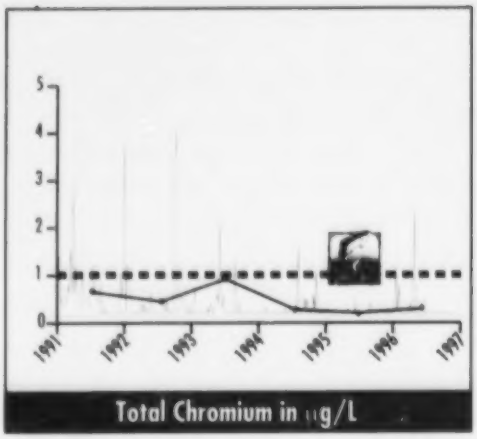
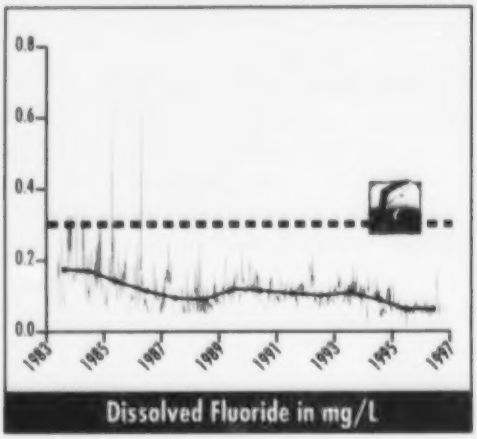
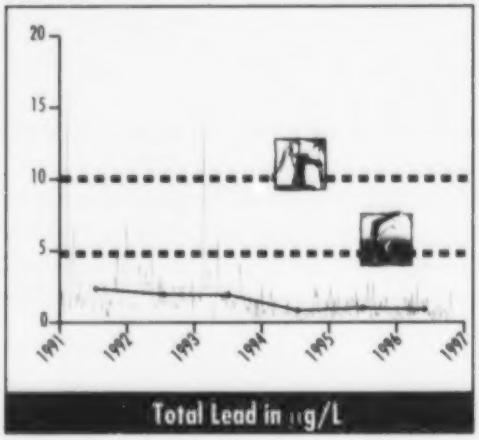


Total Chromium in µg/L



Dissolved Fluoride in mg/L



Total Lead in µg/L

copper, and zinc to safe levels for aquatic life consistently. The declining trend in phosphorus due to waste abatement at the Cominco fertilizer plant improved water quality because the levels were high enough to cause objectionable algal blooms, and there were other pollutants discharged with the phosphorus.

Are there any other water quality concerns?

Yes. There are concerns about total dissolved gas pressure levels that exceeded the safe level for fish as outlined for the Columbia River at Birchbank. The water quality of the Columbia River between Birchbank and Waneta was not evaluated in the 1996 B.C. Water Quality Status Report.

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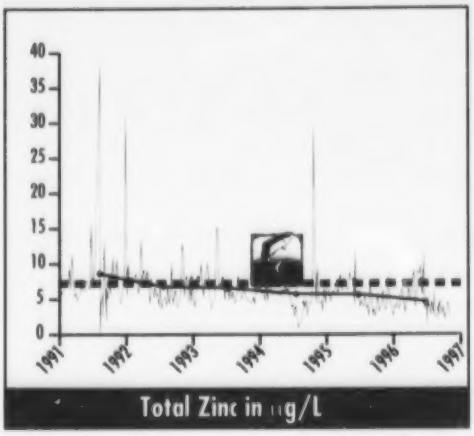
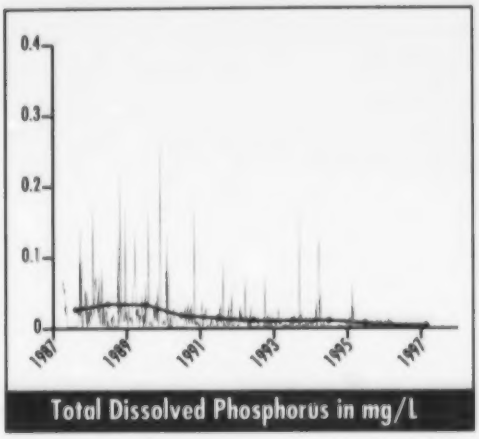
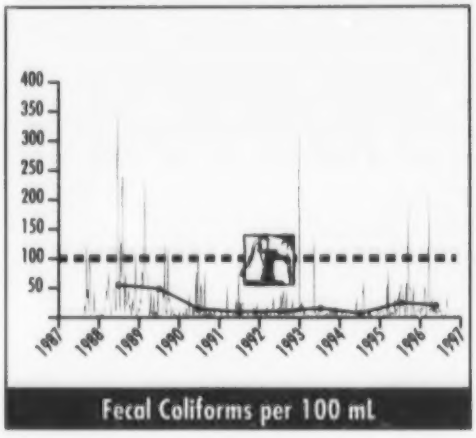


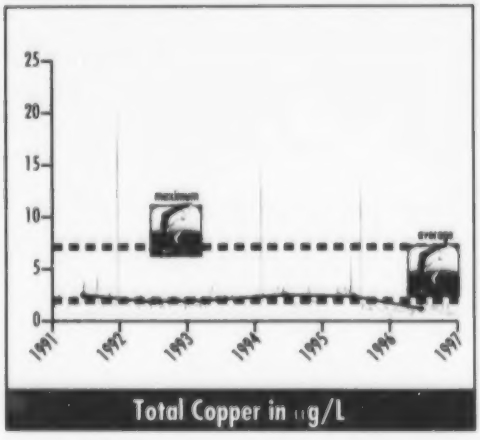
Total Zinc in µg/L



Total Dissolved Phosphorus in mg/L



Fecal Coliforms per 100 mL



Total Copper in µg/L

What will be done to further improve water quality?

Further improvement is needed to reduce cadmium, chromium, copper, and zinc consistently to levels that are safe for aquatic life. Waste abatement at the Cominco smelter is on-going to achieve this. Action is underway to reduce total dissolved gases in the Columbia River basin as outlined for the Columbia River at Birchbank. Monitoring is continuing at the Columbia River at Waneta and total gas pressure monitoring has been started.

Pend D'Oreille River at Waneta

What are the water quality trends?
There were no environmentally significant changes.

No changes

What are the main attributes of the Pend d'Oreille River at Waneta?

The drainage area of the Pend d'Oreille River at Waneta is about 66,600 km^2, 98% of which is in the United States. Only the last 22 km of the river before it joins the Columbia River at Waneta lies in B.C. This reach of the river is dominated by hydroelectric facilities.

What are the main human influences on water quality?

We know little about the influences on water quality in the US portion of the watershed, except that there were two lead-zinc mines along the river in Washington State. There are two closed lead-zinc mines in the B.C. portion of the watershed. Three hydroelectric dams influence the B.C. reach of the river: Boundary Dam at the US-Canada border, Seven Mile Dam, and Waneta Dam just upstream from the Pend d'Oreille's confluence with the Columbia River.

What water quality indicators were monitored?

Major ions, trace elements, nutrients, colour, dissolved and suspended solids, pH, and temperature were monitored once every four weeks since 1980. Flow has been monitored continuously where the river enters B.C.

What are the water quality trends and what caused them?

There were no environmentally significant changes from 1980 to 1995.

Are there any other water quality concerns?

Yes. The levels of total dissolved gases exceeded the safe level for fish downstream from the dams on the Pend d'Oreille River at times. The water quality of the Pend d'Oreille River was not evaluated in the 1996 B.C. Water Quality Status Report.

What will be done to improve water quality?

Water use planning is being conducted with B.C. Hydro for all dams in the Columbia basin to address total dissolved gas concerns. The Upper Columbia River International Task Force is investigating means to reduce total dissolved gases throughout the Columbia basin in Canada and the U.S. Monitoring is continuing at the Pend d'Oreille River at Waneta and a new site has been added where the river enters B.C. Total dissolved gases will be monitored regularly.

Big Sheep Creek Near US Border

What are the water quality trends?
There were no environmentally significant changes.

No changes

What are the main attributes of Big Sheep Creek?
Big Sheep Creek is a transboundary stream, draining 347 km^2 of the Monashee Mountains in B.C. before entering Washington State, where it joins the Columbia River six kilometres south from the border. There are no licensed water withdrawals from Big Sheep Creek, although it is used for cattle watering. The creek has resident populations of eastern brook trout and rainbow trout.

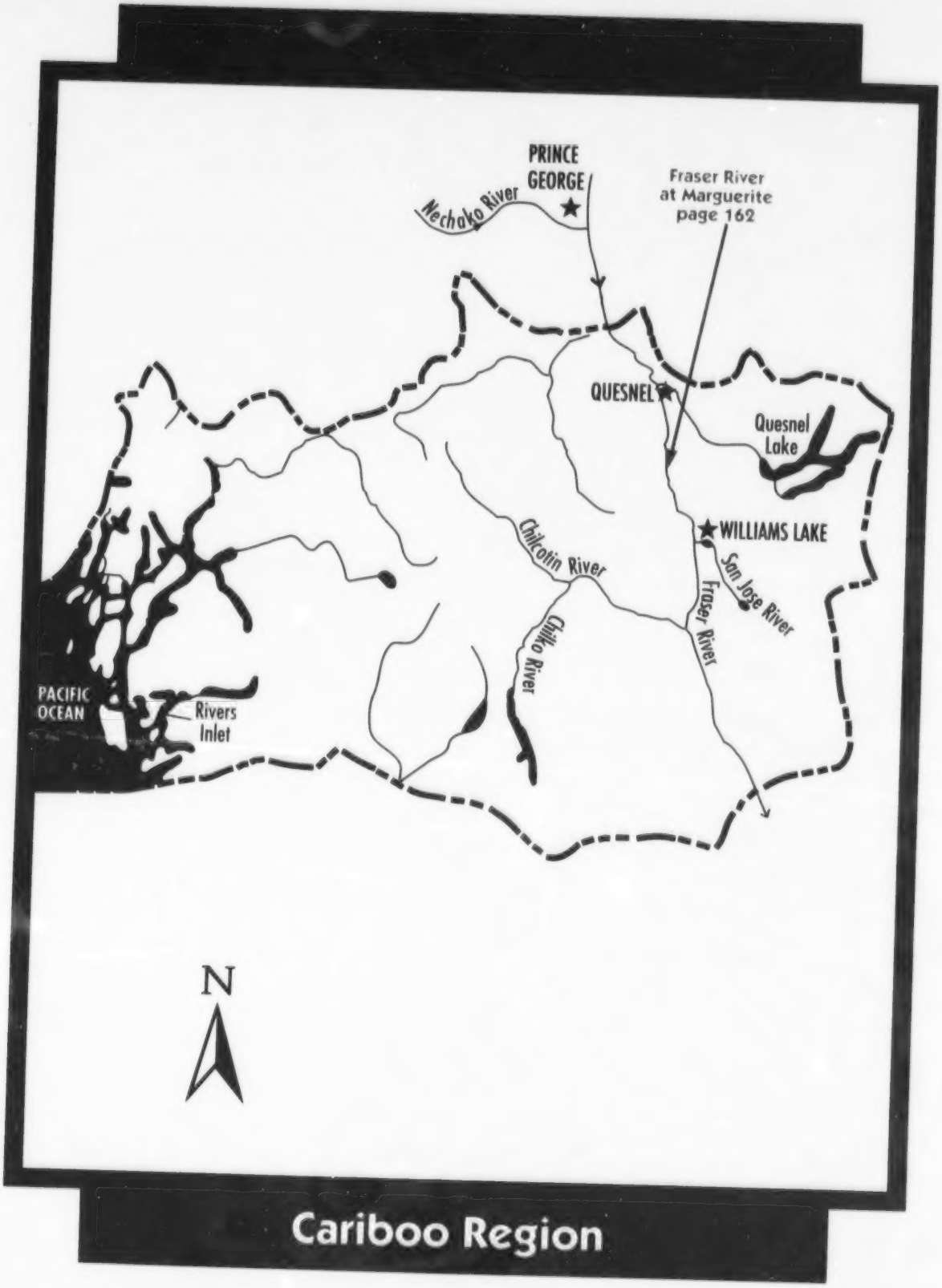
What are the main human influences on water quality?
These include timber harvesting and some cattle grazing. This area has mining potential, and a molybdenum mine and concentrator operated in Little Sheep Creek, a tributary of Big Sheep Creek, from 1966 to 1972. Little Sheep Creek enters Big Sheep Creek downstream from the water quality monitoring station, and thus this station served as an upstream control for the mining.

What water quality indicators were monitored?
Major ions, trace elements, nutrients, colour, dissolved and suspended solids, pH, and temperature were monitored about five times per year from 1979 to 1995. Flow has been monitored continuously.

What are the water quality trends and what caused them?
There were no environmentally significant changes from 1979 to 1995.

Are there any other water quality concerns?
No. The water quality of the Big Sheep Creek was not evaluated in the 1996 B.C. Water Quality Status Report.

Does anything need to be done?
No. There were no apparent water quality changes or concerns during 1979–95, and monitoring was suspended in 1995.



Cariboo Region

CARIBOO REGION SUMMARY

The Cariboo Region is located in the interior of the Province, south from Prince George. It extends from Quesnel Lake in the east to Rivers Inlet on the west coast, and includes a section of the Fraser River as shown on the map opposite. The main BC Environment regional office is located in Williams Lake.

There has been only one long-term water quality monitoring station in this Region on the Fraser River at Marguerite. This station had improving trends in water quality for chlorinated organics and fecal coliforms.

If you have any questions on the trend report or want more information on other waterbodies in the Region, please contact:

Pollution Prevention
Ministry of Environment, Lands and Parks
150 –1st Avenue
Williams Lake, B.C.
V2G 1Y8
Telephone: (250) 398-4543
Fax: (250) 398-4296

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Andrea Ryan
Environment Canada
700 – 1200 West 73rd Avenue
Vancouver, B.C.
V6P 6H9
Telephone: (604) 664-4001
Fax: (604) 664-9126
E-mail: andrea.ryan@ec.gc.ca

Deteriorating Trends in Water Quality

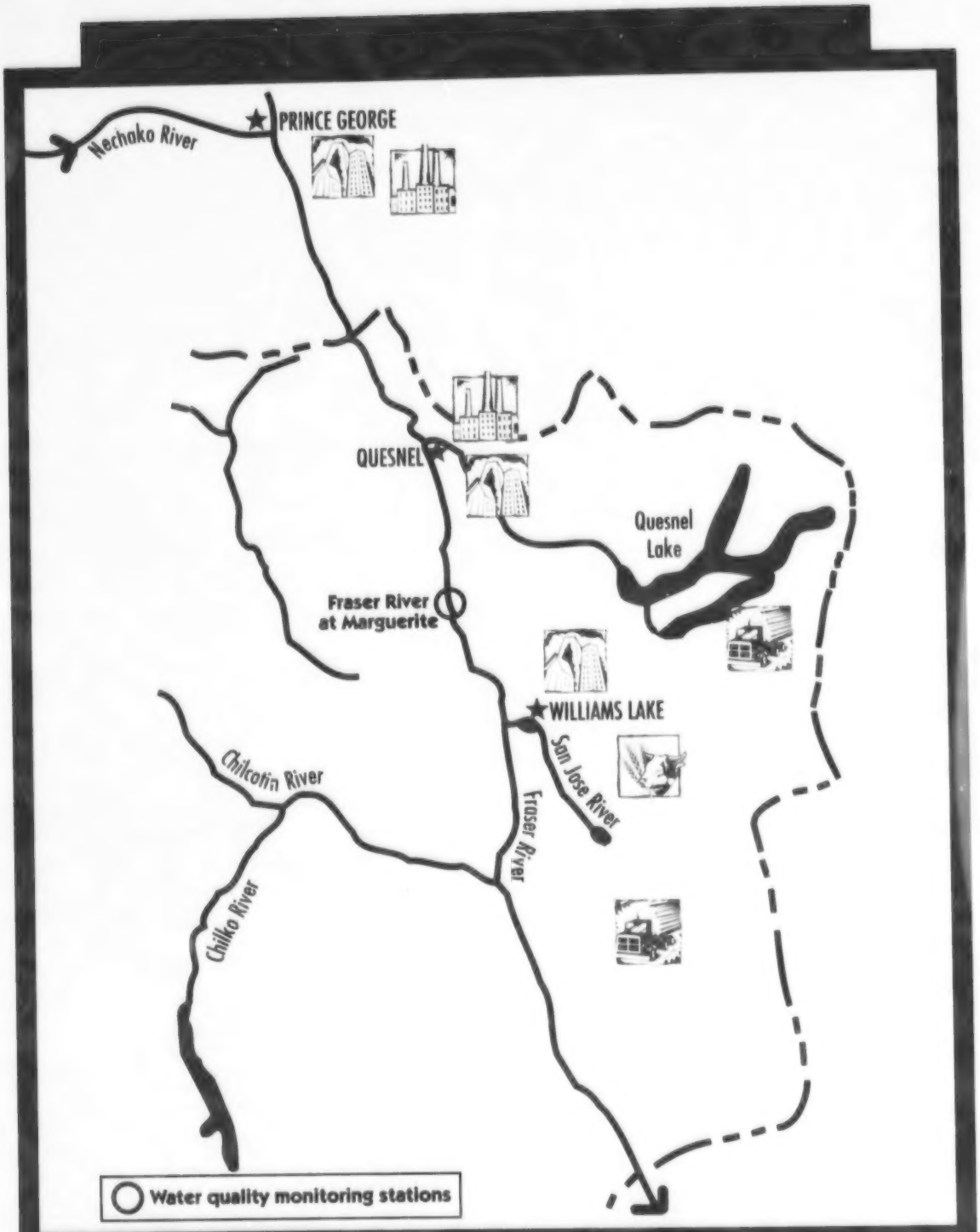
Location (Years)	Water Quality Indicators	Cause of Trend	Water Uses at Risk	Action
None				

Improving Trends in Water Quality

Location (Years)	Water Quality Indicators	Cause of Trend	Water Uses at Risk	Action
Fraser River at Marguerite (1985–96)	AOX Chloride	Pulp mill waste abatement	Aquatic life, and their wildlife and human consumers	Monitoring is continuing.
	Fecal coliforms	Improved sewage treatment	Drinking water, recreation and irrigation	Further monitoring and investigation will be done.

No Changes in Water Quality – Other Water Quality Concerns

Location (Years)	Water Quality Indicators	Concern	Water Uses at Risk	Action
None				



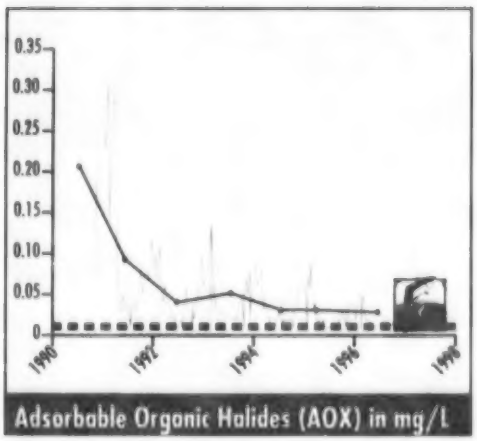
Mid-Fraser River Area

Fraser River at Marguerite

What are the water quality trends?

The Fraser River at Marguerite had improving trends in adsorbable organo-halides (AOX), a general measure of chlorinated organics, and chloride due to waste abatement at pulp mills along the Fraser River. There was also an improving trend in fecal contamination due to improved sewage treatment along the Fraser.

Improving trends



Adsorbable Organic Halides (AOX) in mg/L

What are the main attributes of the Fraser River at Marguerite?

The Fraser River at Marguerite drains 114,000 km^2 of the central portion of the province. The river is used for industrial water supply, recreation, livestock watering and irrigation, and supports massive salmon runs. The Fraser River is a Canadian Heritage River and a B.C. Heritage River.

What are the main human influences on water quality?

These include effluents from three pulp mills at Prince George and two pulp mills at Quesnel, treated sewage effluents from Prince George and Quesnel, and non-point source runoff from forestry, agriculture, and urban areas.

What water quality indicators were monitored?

Major ions, trace elements, nutrients, colour, dissolved and suspended solids, pH, fecal coliforms, adsorbable organo-halides (AOX), and temperature were monitored once every two weeks since about 1985-90, depending on the indicator. Flow has been monitored continuously since 1950. Other Fraser River water quality monitoring stations are located at Red Pass, Hansard, Stoner (see Omineca-Peace Region) and Hope (see Lower Mainland Region).

What are the water quality trends and what caused them?

Chloride and AOX declined since 1990 due to the reduction in chloride and AOX in the effluents from the upstream pulp mills. This was caused by changing the pulp mill bleaching process to reduce the use of elemental chlorine. Fecal coliforms have declined since 1988 due to improved sewage treatment and disposal at Prince George and Quesnel.

What is the environmental significance of the trends?

The decline in AOX indicates that chlorinated organics, which can be toxic to aquatic life and to humans and wildlife that consume aquatic life, have been reduced substantially in the Fraser River. For example, chlorinated phenols in the Fraser River at Marguerite were no longer detectable and met the objectives in 1995. Similarly, dioxins and furans in mountain whitefish muscle declined between 1990-91 and

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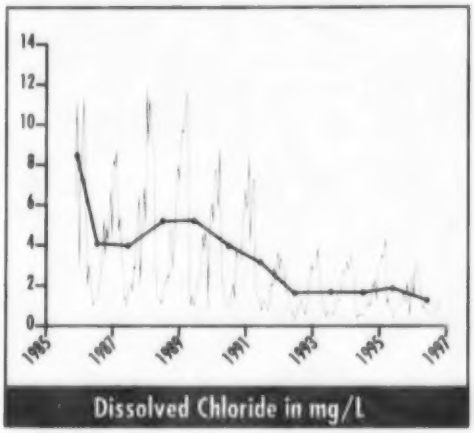
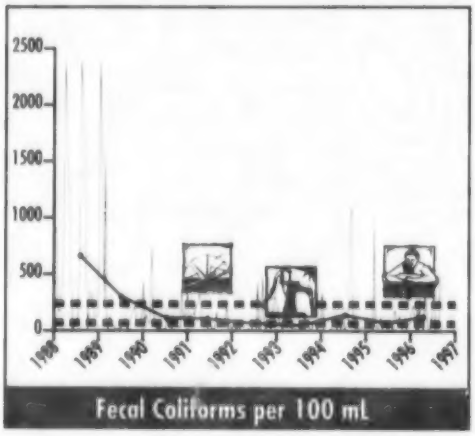


Dissolved Chloride in mg/L



Fecal Coliforms per 100 mL

1995, and met the objective in most fish in 1995. The Ministry of Health lifted restrictions on the consumption of fish muscle in 1994. The objective for AOX was still not attained consistently at Marguerite in 1996, but this is considered to be of low environmental significance because chlorinated phenols and dioxins and furans largely met the objectives in 1995. AOX is merely a surrogate indicator for these chlorinated compounds.

The decline in fecal coliforms indicates that the water was safer for drinking water supply, recreation and irrigation. The objective for fecal coliforms was still not attained consistently, and further monitoring and investigation of sources of fecal contamination are needed to determine abatement options.

Are there any other water quality concerns?

No. The water quality of the Fraser River above Hope was not evaluated in the 1996 B.C. Water Quality Status Report. Additional information on environmental quality in the Fraser River watershed is available in the Environment Canada report, Health of the Fraser River Aquatic Ecosystem – A Synthesis of Research Conducted under the Fraser River Action Plan.

What will be done to further improve water quality?

Further monitoring and investigation of sources of fecal contamination will be done to determine what abatement is needed. Monitoring of the Fraser River at Marguerite is continuing.

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